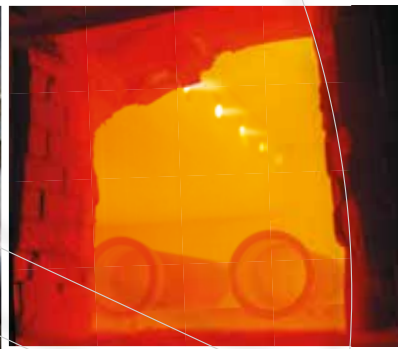


DUCTILE IRON PIPE SYSTEMS

Information of the European Association for Ductile Iron Pipe Systems · EADIPS®

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Brief des Herausgebers

Liebe Leserinnen und Leser,

Die hohen Temperaturen des letzten Sommers haben uns vor Augen geführt, wie wichtig eine funktionierende Versorgung mit Trinkwasser ist, aber auch, wie verwundbar unsere Infrastrukturen sein können. In diesem Zusammenhang wurde sogar von einer „Heißzeit“ gesprochen, einem Ausdruck, der von der Gesellschaft für deutsche Sprache (GfdS) in Wiesbaden zum Wort des Jahres 2018 gewählt wurde. Mit dieser Wahl soll auch auf eines der gravierenden globalen Phänomene des frühen 21. Jahrhunderts, den Klimawandel, hingewiesen werden. Ob und in welcher Form sich die hohen Lufttemperaturen und parallel dazu eine Erhöhung der Bodentemperaturen z. B. direkt auf die Trinkwassernetze auswirken, können wir noch nicht abschätzen.

Einige Städte reagieren bereits heute auf die Auswirkungen des Klimawandels und stellen Ihren Bürgern kostenlos Trinkwasser aus öffentlichen Trinkbrunnen zur Verfügung. So werden in Berlin weitere 100 Trinkbrunnen aufgestellt. Die emaillierten Kaiserbrunnen werden natürlich aus dem langlebigen und wiederverwertbaren Werkstoff Gusseisen hergestellt. Wichtiger Nebeneffekt: auf diese Weise wird auch den Müllbergen aus Plastikflaschen der Kampf angesagt.

Während die Qualität von oberirdisch aufgestellten Brunnen aus Gusseisen beim Vorbeigehen ins Auge springt, sind Informationen über unterirdische Rohrleitungssysteme schwerer zu erhalten.

In den Freispiegelkanälen von Abwassersystemen hat sich die optische Inspektion mit Kamerasystemen als anerkannte Regel der Technik etabliert. Um den Zustand von vollgefüllten Abwasserleitungen, wie z. B. Abwasserdükern, bewerten zu können, müssen die Kanalnetzbetreiber über den Tellerrand schauen. So auch im Fall der Reinigung und Inspektion eines Doppelrohrdükers aus duktilen Gussrohren unter der Mosel am „Deutschen Eck“ in Koblenz. Durch den Einsatz von Inspektionstechnik aus dem Bereich von Pipelines ließ sich nachweisen, dass die umhüllten und ausgekleideten duktilen Gussrohre auch nach 44 Betriebsjahren in einem guten Zustand sind und weiter betrieben werden können.

Die weiteren spannenden Beiträge in diesem Heft zeigen, dass es für jeden Anwendungsfall passende Schutzarten von Rohren, Formstücken und Armaturen aus duktilem Gusseisen gibt. Umhüllungen und Auskleidungen von Rohren, Formstücken und Armaturen bieten Schutz vor mechanischen und chemischen Einwirkungen, sowohl beim Einbau in geschlossener (HDD- oder Rohreinzugs-Verfahren) als auch in offener Bauweise.

Lassen Sie sich inspirieren!



Es grüßt Sie herzlich

A handwritten signature in blue ink, appearing to read 'C. Bennerscheidt', written in a cursive style.

Christoph Bennerscheidt

Letter from the editor

Dear Readers,

The high temperatures of last Summer have made us aware of just how important a functioning supply of drinking water is, but also of how vulnerable our infrastructures can be. In this connection people have been talking of a “hot age”, a term which was selected by the German Language Association as its word of the year for 2018. This fact highlights one of the serious global phenomena of the early 21st century – that of climate change. Whether and in what way the high air temperatures, and in parallel to this an increase in soil temperatures, will have a direct effect on our drinking water networks we cannot estimate as yet.

Some towns and cities are already reacting to the effects of climate change and are making drinking water from public drinking fountains freely available to their citizens. In Berlin for example a further 100 drinking fountains are being installed. The enamelled Kaiser drinking fountains are naturally being constructed of durable and recyclable cast iron. And an important side effect: this also contributes to the battle against the mountains of discarded plastic bottles.

While the quality of cast iron drinking fountains installed above ground is clear to see for every passer-by, information about underground piping systems is harder to obtain. With conventional gravity sewer systems, CCTV sewer inspection systems have become the established state of the art. But in order to assess the condition of completely full sewage pipes, such as wastewater culverts for example, sewage network operators need to think outside the box. And this

is also the case when it comes to cleaning and inspecting a double-pipe culvert of ductile iron pipes under the River Mosel at the “Deutschen Eck” in Koblenz. With the use of inspection technology from the pipeline sector it was possible to check that the coated and lined ductile iron pipes are in good condition even after 44 years of operation and can continue to give service.

The other fascinating articles in this issue demonstrate that there are appropriate ways of protecting ductile cast iron pipes, fittings and valves for every application. Coatings and linings offer protection against mechanical and chemical damage for pipes, fittings and valves whether they are installed using trenchless techniques (HDD or pipe-pulling) or laid in open trenches.

Let yourself be inspired!

Warmest greetings



Christoph Bennerscheidt

Schnellübersicht / Abstracts

Jahresbericht 2018 und Ausblick 2019

Manfred Künze und Christoph Aigner

Die übergeordneten Handlungsfelder der EADIPS FGR Digitalisierung der Wasserwirtschaft, Anpassungsmaßnahmen an den Klimawandel (Schwammstadt) und effizienterer Umgang mit den uns zur Verfügung stehenden Ressourcen wurden im Jahr 2018 weiterentwickelt und in konkrete Projekte überführt. Im Bereich der Digitalisierung ist es die Standardisierung einer rückverfolgbaren Kennzeichnung von Rohren, Formstücken und Armaturen. Im Bereich Ressourceneffizienz ist es die Zusammenarbeit mit der GET – Gütegemeinschaft Entwässerungstechnik zur Gründung einer RAL-Gütegemeinschaft „Duktile Gussrohre, Formstücke und Armaturen“. Durch die Wahl eines neuen stellvertretenden Vorstands werden die Zukunftsthemen auf Vorstandsebene jetzt von Manfred Künze als Vorsitzender des Vorstands und Christoph Aigner als stellvertretender Vorstand vorangetrieben.

Die Deutsche Gießerei-Industrie

Mario Mackowiak, Manfred Künze und Christoph Aigner

An den Daten des Bundesverbandes der Deutschen Gießerei-Industrie (BDG) lassen sich die Veränderungen ablesen, die die deutschen Gießereien in den letzten 15 Jahren durchgestanden haben. Vor allem dominieren heute China und Indien die Statistiken der weltweiten Herstellung. Die weitaus meisten deutschen Gießereien mit bis zu 249 Mitarbeitern zählen zu den kleineren und mittleren Betrieben. Umweltauflagen für die Produktionsstandorte, erhöhte Energiekosten und stark schwankende Rohstoffpreise belasten diese Betriebe im internationalen Wettbewerb. Eine Chance könnten verschiedene Umweltaktivitäten der EU und des Bundes sein, welche sich die „Ressourceneffizienz“ auf die Fahne geschrieben haben, so z. B. im Bauwesen, wo auf dem Sektor des Baustoffrecycling die Anforderungen steigen werden. EADIPS FGR als Europäischer Verband der Hersteller duktiler Guss-Rohrsysteme strebt die Bildung eines europäischen Dachverbandes der Hersteller und Anwender von gegossenen Bauprodukten an, die als „Initiative Guss“ mit weiteren europäischen Herstellern und Anwendern von gegossenen Bauprodukten die EU-Kommission darin unterstützt, geeignete Maßnahmen zur Erreichung der 2015 in

Annual report 2018 and perspective in 2019

Manfred Künze and Christoph Aigner

The digitisation in the water supply industry, measures for adapting to climate change (Sponge City) and even more efficient handling of resources are the most important fields of activity of EADIPS FGR. In 2018 they were developed further into practical projects. In the field of digitization a standard for the identification and traceability of ductile iron pipes, fittings and valves is being developed. In the field of resources EADIPS FGR and GET – Gütegemeinschaft Entwässerungstechnik are cooperating to establish a RAL quality mark for ductile iron pipes, fittings and valves. Based on the election of a new deputy board the most important fields of activity will be pushed forward by the Chairman of the board Manfred Künze and the deputy board Christoph Aigner.

About the German foundry industry

Mario Mackowiak, Manfred Künze and Christoph Aigner

In the data of the German foundry association (Bundesverband der Deutschen Gießerei-Industrie – BDG) you can read about some changes which German foundries have experienced in the last 15 years. Above all, these days China and India are dominating the statistics of worldwide manufacturing. By far the majority of German foundries with up to 249 employees are considered as small and medium-sized enterprises. Environmental requirements for production locations, increased energy costs and highly fluctuating raw materials prices are burdening these enterprises in international competition. One opportunity could be the various environmental activities of the EU and the Federal government, which have adopted the principle of “resource efficiency”, for example in the construction industry where requirements for the recycling of building materials are increasing. EADIPS FGR, as the European association of manufacturers of ductile iron pipe systems, is striving to form a European umbrella association of the manufacturers and users of cast iron building products which, as “Initiative Guss”, with additional European manufacturers and users of cast building products provides support to the EU Commission to develop appropriate measures for achieving the climate tar-

Paris ausgehandelten Klimaziele unter Berücksichtigung ressourcenschonend hergestellter Bauprodukte zu entwickeln.

Hochschullehrertagung in Koblenz und Wetzlar

Jürgen Rammelsberg und Christoph Bennerscheidt

Die seit langem gepflegte Verbindung mit der Fördergemeinschaft zu Information der Hochschullehrer für das Bauwesen (FIHB) erneuerte sich im Frühjahr 2018 bei einem gemeinsamen Programm in Koblenz und Wetzlar. Zwei praktische Erfahrungsberichte der Stadtentwässerung Koblenz setzten den Schwerpunkt im Zeichen der Langlebigkeit duktiler Gussrohre beim Abwassertransport unter schwierigsten äußeren Bedingungen: in einem begehbaren Abwasserdüker unter dem Rhein konnten die Teilnehmer ihre physische Kondition unter Beweis stellen und gleichzeitig die seit über 40 Jahren in Betrieb befindlichen Rohre selbst begutachten. Das zweite Highlight, ein Düker aus zwei Gussrohrleitungen DN 800 und DN 1250, liegt seit über 40 Jahren unzugänglich unter dem Flussbett der Mosel. Mit Hilfe einer neu entwickelten Streustrom-Messtechnik konnte der praktisch unveränderte Zustand innen und außen nachgewiesen werden. Weitere Vorträge beschrieben die Entwicklungen im Bereich der Digitalisierung in der Rohrnetztechnik sowie bei einem F+E Projekt zur Regenwasserbewirtschaftung in der Schwammstadt. Die Besichtigung der Rohr-Herstellung im Werk Wetzlar und ein begleitender Vortrag zu den Themen „Energie-Einsparungen“ und „Ressourcenschonung durch fast 100 % Recycling“ rundeten die Hochschullehrer-Tagung ab.

Langrohr-Relining in Magdeburg

Andreas Chladek und Uwe Hoffmann

Eine Hauptwasserleitung DN 700, seit 120 Jahren in Betrieb, mit zwei Problemen: Alterungsvorgänge des Materials mit Korrosion und Spongiose sowie unzureichende Fließgeschwindigkeit wegen stark zurückgegangenem Wasserbedarf. Mit dem bewährten Langrohr-Relining nach DVGW-Arbeitsblatt GW 320-1 wurden duktile Gussrohre DN 400 mit längskraftschlüssiger Steckmuffen-Verbindung eingezogen, der Ringraum wurde verdämmt. Der Beitrag zeigt ausführlich die Entscheidungsschritte zur Verfahrenstechnik, die Planungs- und Bauphase. Ökologische und wirtschaftliche Gesichtspunkte werden eingehend beleuchtet. Langrohr-Relining mit duktilen Gussrohren: ein elegantes und wirtschaftliches Verfahren mit erwiesener Nachhaltigkeit, die nächsten 120 Jahre ohne Reparaturen sind gesichert!

gets negotiated in 2015 in Paris taking account of construction products manufactured with the aim of conserving resources.

University Lecturers Conference in Koblenz and Wetzlar

Jürgen Rammelsberg and Christoph Bennerscheidt

The long-nurtured links with the FIHB – a German association which promotes information for university lecturers in architecture and construction engineering – were renewed in Spring 2018 by a joint programme in Koblenz and Wetzlar. Two reports of practical experience with urban drainage in Koblenz highlighted the main points concerning the durability of ductile iron pipes for the transport of wastewater under the most difficult external conditions: by actually entering a walk-in wastewater culvert beneath the Rhine, participants were able to prove their physical fitness and at the same time inspect the pipes which have been in operation for more than 40 years. The second highlight, a culvert consisting of two cast iron pipelines, DN 800 and DN 1250, has remained inaccessible for over 40 years under the bed of the River Mosel. With the help of newly developed stray current measurement technology, the practically unaltered state, both inside and out, was able to be established. Additional presentations described developments in the area of digitisation in piping technology and in an R&D project for rainwater usage using the sponge city principle. An inspection of pipe production at the Wetzlar factory and an accompanying presentation on the subjects of “Energy saving” and “Conservation of resources by almost 100 % recycling” rounded off the Lecturers’ Conference.

Long pipe relining in Magdeburg

Andreas Chladek and Uwe Hoffmann

A DN 700 water main, in operation for 120 years, with two problems: ageing processes of the material with corrosion and spongiosis plus insufficient flow speeds because of a major decrease in water demand. With the tried and tested pipe relining technique as described in DVGW worksheet GW 320-1, DN 400 ductile iron pipes with restrained push-in socket joints were pulled into the old pipe and the annular gap was filled. The article gives a detailed description of the choice of technology and the planning and execution phases. Ecological and economical viewpoints are examined in depth. Pipe relining with ductile iron pipes: an elegant and economical process with proven sustainability – another 120 years without repairs are secured!

Der Zeitpunkt für Harmonisierung ist gekommen

Volker Meyer

Seit langem wird in der Europäischen Union um einheitliche Lebensverhältnisse gerungen, so auch um einheitliche Hygienestandards auf dem Sektor des Trinkwassers. Manche Staaten haben ein weit entwickeltes Regelwerk für die Zulassung von Bauprodukten mit Trinkwasserkontakt, andere Staaten haben auf diesem Gebiet nichts. Für viele Hersteller von Armaturen, Rohren und Formstücken für den Trinkwasserbedarf sind getrennte Zulassungsprüfungen für die Lieferung in die verschiedenen Staaten mit großem finanziellem und organisatorischem Aufwand verbunden, der Vorteil eines EU-Binnenmarktes wird für sie nicht greifbar.

30 europäische Verbände, die sich mit der Herstellung und Lieferung von Werkstoffen und Komponenten rund ums Trinkwasser befassen und mit den europäischen Trinkwasserversorgern verbunden sind, haben sich zu einem europäischen Industrieverband „European Drinking Water“ (EDW) zusammengeschlossen. EDW hat die Initiative ergriffen, die Europäische Kommission bei der anstehenden Überarbeitung der Trinkwasserrichtlinie zu unterstützen, damit künftig jeder EU-Bürger über europaweit harmonisierte Hygieneanforderungen dasselbe hohe Niveau des menschlichen Gesundheitsschutzes genießen kann. Außerdem können dann die Hersteller von Werkstoffen und Komponenten der Wasserversorgung die Vorteile des Europäischen Binnenmarktes nutzen.

100 Trinkbrunnen für Berlin

Jörg Meier

Spätestens im Sommer 2018 mit seinen hohen Temperaturen wurde der Bedarf an öffentlichen Trinkbrunnen deutlich. Der Senat von Berlin hat ein mit einer Million Euro ausgestattetes Programm verabschiedet, 100 zusätzliche neue Trinkbrunnen und Wasserspender im Stadtgebiet zu installieren. Ein künstlerisch von Siegfried Kaiser vor Jahren gestalteter Trinkbrunnen erzählt auf seinem Oberflächenrelief die Geschichte des Trinkwassers. Eines der Mitgliedsunternehmen der EADIPS FGR gewann in Zusammenarbeit mit den Berliner Wasserbetrieben den Auftrag, das vorhandene Modell zu überarbeiten und anzupassen. Die einzelnen Gusskomponenten sind emailliert, damit eine unverwüstliche Oberfläche die Trinkbrunnen im öffentlichen Raum auch nach vielen Jahren noch hygienisch und ansehnlich erscheinen lässt.

Time to harmonise hygiene requirements

Volker Meyer

For a long time, the people of the European Union have been striving for standard living conditions, and the same applies when it comes to uniform hygiene standards in the drinking water sector. Some countries have a very advanced set of regulations for the approval of construction products in contact with drinking water, other countries have nothing in this area. For many manufacturers of valves, pipes and fittings for drinking water requirements, different approval testing for delivery to the different countries means a great deal of financial and organisational expense; the advantage of an EU internal market is not within their grasp.

30 European associations which are involved in the production and supply of materials and components to do with drinking water and have links with the European drinking water suppliers have joined together in a European industrial association “European Drinking Water” (EDW). EDW has taken the initiative to support the European Commission in the upcoming revision of the drinking water directive so that, in future, every EU citizen can enjoy Europe-wide harmonised hygiene requirements of the same high level of protection of human health. In addition, the manufacturers of materials and components for the supply of water will be able to benefit from the advantages of the European internal market.

100 new drinking fountains for Berlin

Jörg Meier

In the Summer 2018 with its high temperatures, if not before, the need for public drinking fountains was clear. In a programme provided with a million euros, the Senate of Berlin has approved the installation of 100 additional new drinking fountains and water dispensers in the city. An artistic drinking fountain designed years ago by Siegfried Kaiser has a surface relief which recounts the history of drinking water. One of the member companies of EADIPS FGR, in collaboration with Berliner Wasserbetriebe, won the contract to revise and adapt the existing model. The individual cast iron components are enamelled so that a robust surface of the drinking fountains in public spaces can still be hygienic and attractive after many years.

Inspektion eines Abwasserdükers nach 44 Betriebsjahren

Hans-Jörg Schulz und Wilhelm Kelb

An einem Anfang der 1970-er Jahre gebauten Düker für Abwasser, Trinkwasser und Telekommunikationsleitungen waren die Betonstrukturen des Oberhauptes sanierungsbedürftig. Doch vor der Entscheidung über Sanierung oder Neubau stand die Frage nach dem Zustand der beiden Abwasserrohre aus duktilem Gusseisen DN 800 und DN 1250. Erstmals kam ein neuartiges Streustrom-Messverfahren in einem Molch zum Einsatz, mit dem die Wand beider Rohre zu 100 % auf Inhomogenitäten (Korrosionsabtrag) untersucht werden konnte, selbst durch Auskleidungen aus Zementmörtel bzw. Epoxidharz hindurch. Die Auswertung der Messdaten ergab nach 44 Jahren Dauerbetrieb keine nennenswerten Veränderungen durch Korrosion. An den Rohrleitungen bestand kein Sanierungsbedarf, sodass die Entscheidung zur Sanierung der Betonkonstruktionen des Oberhauptes in Angriff genommen werden konnte.

Das Generationen-Projekt „Circulago“ der WWZ AG

Marco Nussbaumer

Das Wasser der großen und tiefen Binnenseen in der Schweiz birgt ein riesiges Energiereservoir, welches seit kurzem für die Wärme- und Kälteversorgung von ausgedehnten Siedlungen nutzbar gemacht wird. Dabei wird das Seewasser aus tieferen Lagen über Rohrleitungen zu einem Wärmetauscher gefördert. Dem Sekundärkreislauf kann dann mit elektrisch betriebenen Wärmepumpen der Wärmeinhalt entzogen, auf ein höheres Energieniveau gebracht und zu den Hausheizungen geleitet werden. Beim Bau der Primärleitungen in den See sind anspruchsvolle Leitungsbauverfahren zu bewältigen. Beim geschilderten Projekt am Zugersee wurden Vor- und Rücklaufleitung aus duktilen Gussrohren DN 600 gemeinsam an Doppelrohrschellen fixiert in einen vorher aufgefahrenen Microtunnel mit einem Innendurchmesser von 1,6 m eingezogen. Die längskraftschlüssigen Muffenverbindungen BLS® übernahmen dabei die Zugkräfte. Außen- und Innenschutz sind den äußeren Verhältnissen und dem Medium angepasst.

Inspection of a culvert pipeline after 44 years of operation

Hans-Jörg Schulz and Wilhelm Kelb

On a culvert constructed at the beginning of the 1970s for wastewater, drinking water and telecommunication lines, the concrete structures of the inlet structure were in need of attention. But before deciding on whether to renovate or rebuild, there was the question of the condition of the two sewage pipes, DN 800 and DN 1250, in ductile cast iron. For the first time, a new type of stray current measurement process installed in an inspection pig was used, which was able to examine the wall of both pipes to 100% for irregularities (corrosion damage) even through cement mortar and epoxy linings. After 44 years of continuous operation, the evaluation of the measurement data did not show any noteworthy alterations due to corrosion. There was no need for any work to be done on the pipelines, so the decision regarding the renovation of the concrete structures above was able to be tackled.

The intergenerational project “Circulago” of WWZ AG

Marco Nussbaumer

The waters of the large and deep inland lakes in Switzerland conceal an enormous energy reservoir which has recently been put to use to provide heat and cooling for extensive populations. To do this, water is taken from deep in the lakes and carried to heat exchangers by pipelines. Electrically operated heat pumps can then transfer the heat contained to a secondary circuit, brought up to a higher energy level and routed to domestic heating systems. For the construction of the primary lines in the lake, some challenging pipeline construction processes need to be mastered. With the Lake Zug project described, DN 600 supply and return pipelines of ductile iron pipes fixed together with double pipe clamps were pulled into a previously driven micro-tunnel with an internal diameter of 1.6 m. BLS® restrained push-in joints take up the tensile forces here. External and internal protection is adapted to suit external conditions and the medium carried.

Technische Nutzungs- bzw. Lebensdauer von Dichtungen

Rüdiger Werner

Guss-Rohrsysteme, heutzutage fast ausschließlich mit beweglichen Steckmuffen-Verbindungen eingesetzt, besitzen eine hohe Nutzungsdauer. Hochwertiger Korrosionsschutz und Reserven gegen ungeplante äußere Belastungen sind Grundvoraussetzungen für eine Lebensdauererwartung von 100 Jahren und mehr. Der hier vorliegende Beitrag weist nach, dass auch die Gummidichtung aus dem richtigen Elastomer bei richtiger Konstruktion der Verbindung keine Schwachstelle im System ist. Praktische Erfahrungen aus dem Netzbetrieb und moderne Elastomere finden zu einer erstaunlichen Symbiose zusammen.

Neuer Galgenbucktunnel in der Region Schaffhausen

Roger Saner

Mit dem Bau eines Umgehungstunnels kann die Stadt Schaffhausen den Fahrzeugverkehr in der Stadt nahezu halbieren. Nach den zurückliegenden Erfahrungen mit verheerenden Bränden in Verkehrstunneln gilt der sicheren Löschwasserversorgung in derartigen Projekten die höchste Priorität. Die reichlich vorhandenen Erfahrungen des Herstellers vonRoll in ähnlichen Tunneln waren auch in Schaffhausen von Nutzen: Rohre aus duktilem Gusseisen, Formstücke, Hochleistungshydranten, Absperrarmaturen sowie Be- und Entlüfter aus einer Hand stehen für ein Sicherheitssystem mit höchster Zuverlässigkeit bei geringstem Instandhaltungsaufwand.

Pumpkosten reduzieren und Schäden vermeiden

Jürgen Rammelsberg und Christoph Bennerscheidt

In Transportleitungen fließendes Wasser kann enorme kinetische Energie besitzen. Eingeschlossene Luft als kompressibles Medium muss unbedingt aus der Leitung entfernt werden, denn sie könnte sich an bevorzugten Stellen zu größeren Luftblasen zusammenschließen und damit den durchströmten Querschnitt verringern. Erhöhter Energieaufwand (Pumpstrom) zur Förderung der vorgesehenen Wassermenge wären die Folge; außerdem können Druckstöße mit Schäden am Leitungssystem entstehen. All diese gefürchteten Effekte lassen sich durch Einbau von Be- und/oder Entlüftungsventilen an geeigneten Stellen der Leitung vermeiden. Im Beitrag werden die unterschiedlichen Bauformen und Wirkungsmechanismen von Be- und Entlüftern beschrieben und das entsprechende Technische Regelwerk zitiert.

The technical service life of gaskets

Rüdiger Werner

Cast iron pipe systems, these days almost exclusively used with flexible push-in joints, have a long useful life. High-quality corrosion protection and reserves against unplanned external loads are prerequisites for a working life expectancy of 100 years and more. This article shows that, with the correct construction of the joint, even the rubber gasket in the right elastomer is no weak spot in the system. Practical experience in network operation and modern elastomers together form a surprising symbiosis.

The new Galgenbuck tunnel in the region of Schaffhausen

Roger Saner

With the construction of a bypass tunnel, the town of Schaffhausen can almost halve the vehicle traffic in the town. After past experience of devastating fires in transport tunnels, the highest priority is given to the secure supply of extinguishing water in projects of this kind. The wealth of experience of the manufacturer, vonRoll, in similar tunnels was also a benefit for Schaffhausen: pipes in ductile cast iron, fittings, high-performance hydrants, shut-off valves and air release and ventilation valves from the same supplier are a guarantee of a safety system with the highest reliability and the lowest maintenance costs.

Reduce the costs for pumping and risk of damages

Jürgen Rammelsberg and Christoph Bennerscheidt

In transport pipelines, flowing water can have an enormous amount of kinetic energy. It is essential that trapped air, as a compressible medium, is removed from the pipeline because it could accumulate at favourable points and form large air pockets, hence reducing the cross-section for the flowing water. This could result in increased energy expenditure (pumping power) to convey the amount of water required; in addition, pressure surges can occur with consequent damage to the piping system. All of these dreaded effects can be avoided by the installation of ventilation and/or air release valves at appropriate points in the pipeline. In this article the various construction forms and working mechanisms of these valves are described and the corresponding technical regulations are quoted.

Modernisierung auf Raten

Patricia Pfister

Auf lange Sicht sparen: Das ist das erklärte Ziel der Kärntner Stadtgemeinde Feldkirchen. Deswegen modernisiert die Stadt regelmäßig ihr Wasserleitungsnetz und profitiert dabei von den höheren Fördersätzen, mit denen fleißige Gemeinden für ihr Engagement in Sachen Rohrsanierung belohnt werden. Die alten PVC-Leitungen aus den 1960-er und 1970-er Jahren werden ausgetauscht gegen langlebige und hoch belastbare Gussrohre der Tiroler Rohre GmbH. Mit finanzieller Förderung gibt die Landesregierung den Gemeinden deutliche Anreize, ihre Wasserversorgungsnetze an den neusten Stand der Bevölkerungsentwicklung anzupassen.

Einbau einer Abwasserleitung im Steilhang

Patricia Pfister

Ein nicht alltägliches Projekt ist der Bau einer 1,5 km langen Entwässerungsleitung in einem Steilhang mit 45° Neigung für eine Streusiedlung im österreichisch-italienischen Grenzgebiet des Nassfelds in Kärnten. Skitourismus, aber zunehmend auch höhere Auslastungen im Sommer, führen zu einer extrem schwankenden Abwassermenge zwischen 17.000 und 40.000 Einwohnergleichwerten. Die äußeren Randbedingungen mit möglichen Hangrutschungen stellten die Planer vor Herausforderungen, die sie mit dem Einsatz von duktilen Gussrohren mit zugfesten Verbindungen und Zementmörtel-Umhüllung bewältigten. Die Tiroler Rohre GmbH unterstützten die Planung mit ihrer in ähnlichen Projekten erworbenen Expertise und sammelten in der Bauphase zusätzlich neue Erfahrungen, die sich in künftigen Vorhaben wieder als nützlich erweisen werden.

Trinkwasser-Düker DN 600 unter der Nežárka

Ivan Demjan und Petr Krejčí

Eine Hauptwasserleitung im südböhmischen Veselí hing bisher unter einer Brücke über die Nežárka. Risiken bestanden in zusätzlichen Belastungen der Brücke durch Hochwasser und Vandalismus. Eine deutlich sicherere Lösung bestand in der Unterdükerung der Nežárka mit dieser Leitung. Als fortschrittliches Bauverfahren bot sich der Einzug des Leitungsabschnitts mit dem HDD-Verfahren an. Dabei mussten unterschiedliche geologische Randbedingungen an den beiden Flussufern bewältigt werden. Duktile Gussrohre DN 600 mit Zementmörtel-Umhüllung und zugfesten Verbindungen BLS®, die sich seit langem bei derartigen Projekten bewährt hatten, führten auch hier, in Tschechien zum ersten Mal, zum Erfolg.

Modernisation bit by bit

Patricia Pfister

Saving in the long run: this is the declared aim of the Carinthian municipality of Feldkirchen. Therefore the town is modernising its network of water supply pipes, thereby profiting from higher subsidy rates which reward diligent communities for their commitment to pipeline renovation. The old PVC pipelines from the sixties and seventies are being replaced by durable and highly robust ductile cast iron pipes from Tiroler Rohre GmbH. With its financial support, the state government is giving communities clear incentives to adjust their water supply networks to the latest state of population development.

Installation of a sewer pipe on a steep slope

Patricia Pfister

One project which is certainly not run-of-the-mill is the construction of a 1.5 km long sewer pipe on a steep, 45° slope for a scattered settlement in the region of the Austrian-Italian border called Nassfeld in the state of Carinthia. Ski tourism, but also increasingly high visitor numbers in Summer, are resulting in extremely fluctuating wastewater volumes equivalent to between 17,000 and 40,000 residents. The external conditions with possible landslides set some challenges for the planners, who mastered them with the use of ductile iron pipes with restrained joints and cement mortar coating. Tiroler Rohre GmbH supported the planning with their expertise acquired in similar projects and also managed to gather some new experiences in the construction phase which will prove to be of benefit in future projects.

Installation of a DN 600 drinking culvert under the Nežárka river

Ivan Demjan and Petr Krejčí

A water main in Veselí, South Bohemia, was previously hung beneath a bridge over the Nežárka river. There were risks in the additional loads placed on the bridge by high water and vandalism. A considerably safer solution lay in running this line through a culvert under the Nežárka. Pulling the section of the pipeline through by the HDD process proved to be the best answer. To do this, various geological conditions had to be mastered on both banks of the river. DN 600 ductile iron pipes with cement mortar coating and restrained BLS® joints, which have long since proved themselves in projects of this kind, also resulted in success here, in the Czech Republic, for the first time.

Erneuerung der Trinkwasseraufbereitung im Wasserwerk Sindelfingen

Matthias Müller und Boris Vaihinger

Be- und Entlüfter, Absperrklappen, Schieber, Pass- und Ausbaustücke: wichtige Armaturen und Zubehör für die Anlagen zur Aufbereitung und Verteilung von Trinkwasser unterliegen einem stetigen Druck zur Verbesserung und Optimierung. Am besten gelingt dieser Verbesserungsprozess dann, wenn Anwender und Hersteller dabei in einem engen Verhältnis kooperieren. Nur so lassen sich die Anforderungen des Anwenders auf neue Konstruktionen und Werkstoffe übertragen. Und nur so ist es möglich, dass die Hersteller in einer sich wandelnden Welt des Trinkwassers wettbewerbsfähig bleiben.

Neue Generation von Unterflurhydranten

Matthias Müller

Unterflurhydranten erlauben die direkte Wasserentnahme aus dem städtischen Trinkwassernetz. In erster Linie ist es das Löschwasser, aber auch für Rohrnetzspülungen, Bauvorhaben, Volksfeste und Straßenreinigung kann Wasser über Hydranten dem Netz entnommen werden. Daneben können Hydranten zur Be- und Entlüftung oder zur Entleerung von Rohrleitungsabschnitten, aber auch zur Leckortung durch Korrelationsverfahren genutzt werden. Hydranten müssen als „Alleskönner“ im Netzbetrieb ein breites Anforderungsspektrum erfüllen. So ist es kein Wunder, dass diese Armaturen Teil eines ständigen Optimierungsprozesses sind. Das gilt sowohl für die Konstruktion als auch für die eingesetzten Werkstoffe. So wird z. B. der jüngste Unterflurhydrant der „Oberklasse“ mit einer Absperrkugel aus verschleißfestem Polyurethan ausgestattet, die selbst bei kleinen Fremdkörpern im Ventilsitz dicht abschließt. Eine weitere Finesse ist die Voll-Emaillierung innen und außen mit einem Email, das schlagfest ausgerüstet ist.

Wie erklärt man eine Regelarmatur?

Ursula Vogler und Oliver Jäger

Die physikalischen Effekte der Blasenbildung und Kavitation, wie sie bei ungünstigen Randbedingungen in der Strömung des Wassers durch eine Armatur entstehen, sind von außen nicht sichtbar und können auch in einem „Echtfilm“ nicht sichtbar gemacht werden. Anders in einer Animation, die sich die Daten der CAD-Konstruktion zunutze machen kann. Mit einer detailgetreuen Oberflächennachbildung, der Simulation der Wasserströmung, mit geschickter Betonung wichtiger Details und effektvoller Musikantermalung ist ein Video entstanden, in dem die Vorteile des Düker Ringkolbenventils verständlich vor Augen geführt werden.

Renewal of the drinking water treatment at the Sindelfingen waterworks

Matthias Müller and Boris Vaihinger

Air release and air admission valves, shut-off valves, gate valves, adapters and extensions: essential fittings and accessories for drinking water treatment and supply equipment are subject to constant pressure for improvement and optimisation. At best, this improvement process succeeds if user and manufacturer can cooperate closely with one another. Only in this way can the requirements of users be transferred to new constructions and materials. And only in this way is it possible for the manufacturer to remain competitive in the changing world of drinking water.

A new generation of underground hydrants

Matthias Müller

Underground hydrants allow water to be taken directly from the municipal drinking water network. First and foremost, this is extinguishing water, but water can also be drawn by hydrants from the network for flushing piping systems, building projects, fairs and carnivals and street cleaning. In addition, hydrants can be used for aeration and ventilation or for draining sections of pipeline, but also for detecting leaks using the correlation process. Hydrants must be the „all-rounders“ in network operation, meeting a broad range of requirements. So it is no wonder that these fittings are part of a constant process of optimisation. This applies both to construction and to the materials used. So, it is no wonder, for example, the most recent „top class“ underground hydrant is equipped with a shut-off ball in wear-resistant polyurethane which prevents even small foreign particles from getting into the valve seat. A further refinement is the all-over enamelling, inside and outside, with an enamel which makes it impact resistant.

How to explain the function of a control valve?

Ursula Vogler and Oliver Jäger

The physical effects of bubble formation and cavitation which, under unfavourable conditions, occur when water flows through a valve are not visible from outside and can also not be seen in a „real film“. This is not the case in an animation which can make use of the data from a CAD construction. With a reproduction of the surface which is accurate in every detail, the simulation of the flow of water, with skilful emphasis of important details and effective background music, a video has been produced in which the advantages of the Düker plunger valve are made clearly comprehensible.

Newsletter EADIPS FGR



EADIPS® European Association for
Ductile Iron Pipe Systems
FGR® Fachgemeinschaft Guss-Rohrsysteme

NEWSLETTER

Dear Readers,

most components of ductile iron pipe systems in water distribution networks are installed underground and form an invisible network. In public areas it is accessible on the surface via hydrants, e.g. for the extraction of extinguishing water, for the ventilation of pipelines or for flushing. This issue of the EADIPS Newsletter provides an insight into the different designs of hydrants.

In other locations, valves are installed easily accessible; this is the case at the Sindelfingen waterworks. According to its corporate philosophy „Think globally - act locally“, ecological considerations are an important part of the strategy concept of Stadtwerke Sindelfingen. This is why butterfly valves and adapters and extension pieces in pipelines as well as ventilation valves on modern single-layer filters guarantee the safe operation of three different systems for drinking water treatment.

The increase in congestion in the Schaffhausen region led to the construction of the Galgenbuck Tunnel, which crosses the community of Neuhaus am Rheinfall in a wide arc over a total distance of 1,138 m. Such projects are no longer conceivable without a functioning extinguishing water supply. Water pipes and hydrants made of ductile cast iron are the first choice in these cases.

Have an enjoyable and stimulating read
Sincerely yours

Christoph Bennerscheidt

Always current, always informed

The periodically published Newsletter provides specialists in the sector with the latest information on interesting European pipeline Projects as well as the many and varied activities of EADIPS FGR.



Register at:
eadips.org/newsletter-e/

Duktile Gussrohre als Problemlösung im Kleinwasserkraftwerk in Cortina d'Ampezzo

Der hohe Energiebedarf mit unerschöpflicher Wasserkraft ab. Dabei sind die strengen Anforderungen an die Wasserkraftanlagen jedoch ein großes Hindernis. Deswegen erfordern immer mehr Projekte, die besondere Herausforderungen für Technologie und Konstruktion bereithalten. Die in der letzten Ausgabe des EADIPS Newsletters erwähnte Kleinwasserkraftanlage Cortina erreichte mit zwei Pumpenstationen eine Leistung von 4,3 MW. Das Projekt eines Kleinwasserkraftwerkes in Italien zeigt eindrucksvoll das große Potenzial duktiler Gussrohre.



Die Rohre, die jeweils durch zwei 22" - Bögen getrieben sind, decken den 375 m langen Flutstrom ab. Die Installation ist das Problem der ständigen Drehbewegung jedoch nicht vollständig. Ein **TEUF** aus der Beschleunigungstechnik bietet jedoch die geforderte Flexibilität. Standard-Flutströme können an der Drehbewegung bis zu 50 cm aufnehmen. Für die beschriebene 40 stufenanlage sind **schwermetalle** Flutstücke entwickelt, die bei einer Länge von 1,80 m bis zu 80 cm Bewegung

Rohre mit flexibler Verbindung

Die Rohre werden die Zugkräfte von den **Steckmuffenverbindungen** auf die Flutströme übertragen. Die Flutströme sind jedoch nicht vollständig. Ein **TEUF** aus der Beschleunigungstechnik bietet jedoch die geforderte Flexibilität. Standard-Flutströme können an der Drehbewegung bis zu 50 cm aufnehmen. Für die beschriebene 40 stufenanlage sind **schwermetalle** Flutstücke entwickelt, die bei einer Länge von 1,80 m bis zu 80 cm Bewegung



Einbau duktiler Gussrohre DN 900

Die schnelle und sichere Montage der **ELS-Steckmuffenverbindungen** führen zu einer Baustelle von nur zwei Wochen für den Einbau von 375 m **duktiler Gussrohre DN 900** inklusive der Drehungsausgleichstücke. Aufgrund der **ELS-Steckmuffenverbindungen** entstehen zusätzliche Schwierigkeiten, Prüfungen, mechanische Oberflächenbehandlungen und Betonüberläufe.

Einbau der Druckrohrleitung war schwierige Aufgabe

Drei Monate später erntete die Gemeinde Sitten die Bauleistung. Als bauliche Herausforderung ist neben der Festlegung der Wasserfassung auch der Einbau der **Druckrohrleitung** im oberen Trausenschnitt bis hin zur Fassung anzusehen, eine insbesondere die auch geologisch anspruchsvolle Aufgabe. Insgesamt erstreckt sich die **Rohrleitungstrasse über 1.800 m** durch unebenes Gelände. Als Rohrmaterial der Wahl boten die Betreiber **duktiler Gussrohre DN 1000** in schwarz und zugsicherer Ausführung. Geliefert wurden sie vom **Schweizer Rohrpedialisten TMH Hagerbucher AG** (Zürich).



Widerstandsfähigkeit und Langlebigkeit duktiler Gussrohre

Duktile Gussrohre sind für diese Bedingungen optimal geeignet. Das hat nicht nur mit der hohen **Widerstandsfähigkeit und Langlebigkeit** der **Rohre aus Gusseisen** zu tun, sondern auch mit der einfachen Art ihres Einbaus. Der Graben wird ausgehoben und das **Gussrohr** auf der Grabensohle ausgerichtet.

Manfred Künze and Christoph Aigner

Annual report 2018 and perspective in 2019

The high temperatures this Summer have made us aware of just how important a functioning supply of drinking water is, but also of how vulnerable our infrastructures can be. In this connection people have been talking of a “hot age”, a term which was selected by the German Language Association as its word of the year for 2018. This fact highlights one of the most serious global phenomena of the early 21st century – that of climate change. Whether and in what way the high air temperatures and the resulting increase in soil temperatures will have a direct effect on our drinking water networks we cannot estimate as yet. But we need to keep a close eye on this.

This makes it even more important that we know more about the operating status of our underground supply networks. At this juncture, digitalisation in the water supply industry can make an important contribution to improving our understanding of operating conditions. Against this background, a trailblazing decision has been made by the members of EADIPS FGR to get together in the “Digitalisation” working group and look at the processes of production, sales, installation and operation of pipes, fittings and valves.

At this point we would like to thank the members of EADIPS FGR for their cooperation and support:

Full members

- Düker GmbH
- Duktus (Wetzlar) GmbH & Co. KG
- Erhard GmbH & Co. KG
- Ludwig Frischhut GmbH & Co. KG
- Keulahütte GmbH
- Tiroler Rohre GmbH
- vonRoll (hydro) suisse ag
- vonRoll (hydro) deutschland gmbh sowie

Sponsoring members

- Akzo Nobel Powder Coatings GmbH
- Friedrichshütte GmbH
- Rhein-Ruhr Collin KG Geschäftsbereich HTI
- TMH Hagenbucher AG
- Träger + Entenmann KG
- Saint-Gobain Building Distribution Deutschland GmbH
- SATTEC DBS GOMMA SRL
- Vertriebsgesellschaft für Tiefbau und Umwelttechnik mbH + Co. KG
- Woco IPS GmbH Business Unit Pipe System Components

Something that it worth emphasising is that the two topics for the future – the “Sponge City” and “Resource Efficiency” – are also closely linked with the subject of climate change.

Organisational matters

The future-oriented topics of the **sponge city**, **digitalisation** and **resource efficiency** were also discussed at the members’ meeting of EADIPS FGR, which was held



Manfred Künze,
Chairman of
the Board



Christoph Aigner,
Vice Chairman of
the Board

on 13 November 2018 in Erding (Bavaria), and resolutions were passed on the further development of these subjects. In addition, Christoph Aigner (Tiroler Rohre GmbH) was elected as the new Deputy Chairman. Manfred Künze (Duktus (Wetzlar) GmbH & Co. KG and Keulahütte GmbH), as Chairman, will be steering the fortunes of EADIPS FGR in future.

Public relations

The public relations of EADIPS FGR will continue to concentrate on three areas which are closely linked to each other:

- Publications in print media
- Internet/social media
- Trade fairs/exhibitions/symposiums

A symposium of a special kind was the FIHB University Lecturers Conference 2018 in February 2018. The FIHB is a German association which promotes information for university lecturers in construction engineering. Organised by EADIPS FGR, it took place in Koblenz and Wetzlar under the motto "Ductile iron pipe systems: operation, climate change and digitalisation". Particular attention was paid to the combination of inspection in practice during the visit to the walk-in culvert beneath the Rhine in Koblenz and reports by network operators and measurement engineers as well as the descriptive reports by cast iron pipe experts on their latest developments, such as the sponge city principle and the resource efficiency of ductile iron pipe systems. Naturally, an account of the University Lecturers Conference 2018 is reported in this Annual Journal. Which means that, once again, issue 53 of the "Ductile Iron Pipe Systems" Annual Journal serves as a basis for dissemination of expert knowledge about ductile iron pipe systems in the different specialist media.

"A picture is worth more than a thousand words" and "with moving images you can get important messages across more easily"; this also applies to the recycling ability and closed cycle of "cast iron" as a material. This is demonstrated in the brief video "Cradle-to-Cradle" published in the social media so successfully. But short clips about applications such as "Push-in-joints" or "Interim pipelines in ductile cast iron" have also attracted a great deal of attention. In a similar way, further videos are going to be produced and published in the social media in 2019. In addition, videos and animated presentations will be used at trade fairs, exhibitions and symposiums to illustrate the themes for the future to the professional public. The type of support provided by members of EADIPS FGR at IFAT 2018 was a particular feature



Slide shows: Cradle-to-Cradle and Push-In Joints for Ductile Iron Pipes.

here: EADIPS FGR was invited to be available for talks at members' stands at the trade fair. And then reports of IFAT 2018 with pictures and video clips were published "live" on the social networks.

Set of Rules

Collaboration in the matter of rules and regulations was developed further in 2018. This means that EADIPS FGR now has a presence at ISO meetings taking place across the world.

From the Association's point of view, this step is necessary in order to contribute to the increasingly important role of the ISO in standardisation work. China and India have created huge casting capacities, not least in the field of cast iron pipe system production (take a look at the article by Mario Mackowiak on page 14). Experts in both countries are making loud demands for participation in the corresponding international product and system standards.

EADIPS FGR and/or its members are represented on the committees listed below and are taking an active part in the revision or development of standards in various fields:

- **ISO TC 5 SC 2:** Cast iron pipes, fittings and their joints
- **CEN TC 203:** Cast iron pipes, fittings, accessories and their joints
 - WG 7: Influence of non-metallic materials used in iron pipelines on water quality
 - WG 8: Coatings for pipes, fittings and accessories
 - WG 9: Revision of EN 545, EN 598 and EN 969
- **DIN NA 082:** Standards committee for pipelines and steam boiler equipment (NARD)
 - NA 082 BR: NARD advisory board
 - NA 082-00-05 AA: Mirror committee for TC 203, excluding EN 598
- **DIN NA 119:** Standards committee for water management (NAW)
 - NA 119 BR: NAW advisory board
 - NA 119-05-32 AA: Mirror committee for TC 203, EN 598
 - NA 119-07-17 AA: Metal pipes and pipe joints for piping systems outside buildings (DIN/DVGW joint committee)
- **Drinking water hygiene**
 - UBA – German Federal Environment Agency: collaboration in the "Cement" working group
 - FIGAWA: Collaboration in the "Valves" working group and the "Elastomers" working group
 - EDW: European Drinking Water

Members of EADIPS FGR are chairmen or vicechairmen in the following committees:

- CEN TC 203/WG 7: Influence of non-metallic materials used in iron pipelines on water quality
- CEN TC 203/WG 8: Coatings for pipes, fittings and accessories
- DIN NA 082-00-05 AA: Mirror committee for TC 203, excluding EN 598
- DIN NA 119-05-32 AA: Mirror committee for TC 203, EN 598

Themes for the future

Continued development of the three EADIPS FGR themes for the future – the **sponge city**, **digitalisation** and **resource efficiency** – also took a further step forward in 2018. While the sponge city and digitalisation topics have already been able to be transformed into concrete project work, a priority for work in 2019 will be to break the subject of resource efficiency down into concrete projects. A first project is the collaboration of EADIPS FGR with the quality association for drainage technology (Gütegemeinschaft Entwässerungstechnik e.V. or GET) to set

up the RAL “Ductile iron pipes, fittings and valves” quality association. In future, in the newly formed Sector 8 of GET, quality guidelines will be established for the RAL “Ductile iron pipes, fittings and valves” quality mark: the founding members are the full members of EADIPS FGR. In addition, at the 2018 members’ meeting, it was unanimously decided to bring the cycle-oriented solutions already in existence, as developed by the European casting industry, to the attention of the decision-makers.

Authors

Manfred Künze
Chairman of the Board
of EADIPS FGR

Christoph Aigner
Vice Chairman of the Board
of EADIPS FGR

EADIPS®/FGR®
European Association for
Ductile Iron Pipe Systems/
Fachgemeinschaft Guss-
Rohrsysteme e. V.
Doncaster-Platz 5
D-45699 Herten
Phone: +49(0)2366 9943905
info@eadips.org
eadips.org



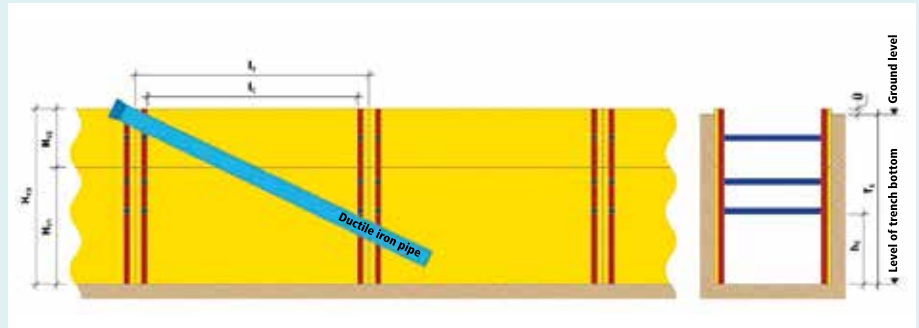
From the EADIPS FGR folder series DATA + FACTS: The future topics sponge city, digitalisation and resource efficiency. All folders of the series as well as further publications of the EADIPS FGR are available for download at eadips.org.

Trench shoring systems

Trench shoring systems are used for the secure and accelerated installation of pipes in utility trenches. There are three options for installing ductile iron pipes up to 6 m long which can also be called up in the Online Tools on the EADIPS FGR website:

Option 1: Inserting the pipe within one shoring unit

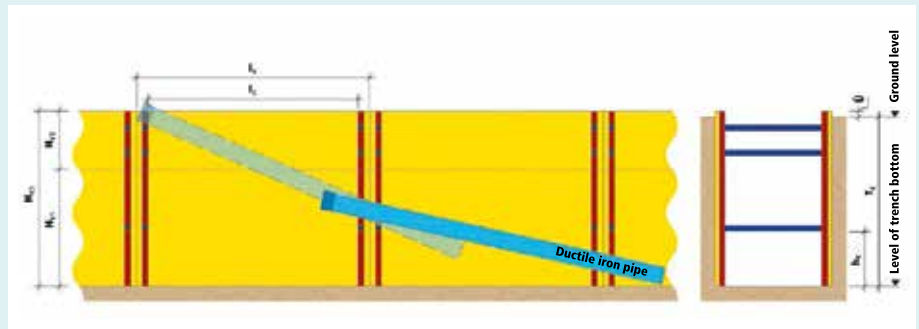
Option 1 shows a schematic diagram of the process of inserting a ductile iron pipe within one shoring unit. The cast iron pipe can be supported by two slings to do this (one approximately in the middle and one in the socket area) and threaded into the trench beneath the lowest level of struts.



Option 1:
Edge-supported shoring units, inserting the pipe within one shoring unit.

Option 2: Inserting the pipe within two shoring units

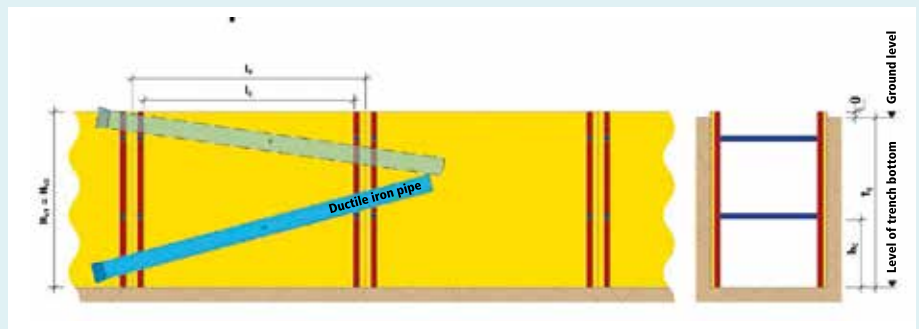
Where the lowest level of struts is very deep, geometric factors may mean that the pipe cannot be threaded in within just one shoring unit but that two units are required for this. This complicates the threading process as the slings have to be attached and removed. A secure fixing of the pipe must always be ensured here.



Option 2:
Edge-supported shoring units, inserting the pipe within two shoring units.




Option 3: Swinging in

To swing in the pipe a sling is attached to its centre of gravity. By changing its inclination while simultaneously guiding it horizontally the pipe is positioned on the pipe bed inside one shoring unit. As the inclination and guiding of the pipe is assisted manually, attention needs to be paid to the secure attachment of the pipe; inclining the pipe too steeply is to be avoided.



Option 3:
Edge-supported shoring units, swinging in.

Key:

H_{V1}	height of ground shoring	l_V	length of shoring unit	T_E	installation depth ($= H_{V3} - \ddot{U}$)
H_{V2}	height of top unit	l_c	pipe passage length	\ddot{U}	protrusion of shoring unit above ground level ($= 0.1 \text{ m}$)
H_{V3}	height of shoring unit	h_c	pipe passage height		
		OK	top		
	Shoring panels		Vertical bars		Horizontal struts

Mario Mackowiak, Manfred Künze and Christoph Aigner

About the German foundry industry

Facts and figures, structures and markets

Cast metal components are not merely used for media transport, particularly water and wastewater. Across the world, cast components can be found in almost all branches of industry. The reasons for this are diverse. Worth mentioning here are e.g. the mechanical properties of the different cast materials and the fact that, in the liquid state, metals can take on almost any geometric form desired and, once cooled, have a high loadbearing capacity. Traditionally, a distinction is made between two main groups of cast materials – ferrous cast materials and non-ferrous metal cast materials.

For 2019, the current monitoring of the market by the German foundry industry association (BDG) does not show any clear trend. However, a certain slowdown or possibly even a slight fall in demand is very probable.

In the global classification, German ferrous and non-ferrous casting has been stable for a few years, occupying the 5th spot on a par with Japan.

The six countries of China, India, USA, Japan, Germany and Russia alone produced around 82 million

tonnes in 2017, which was 79 % of the world’s foundry production of 104 million tonnes.

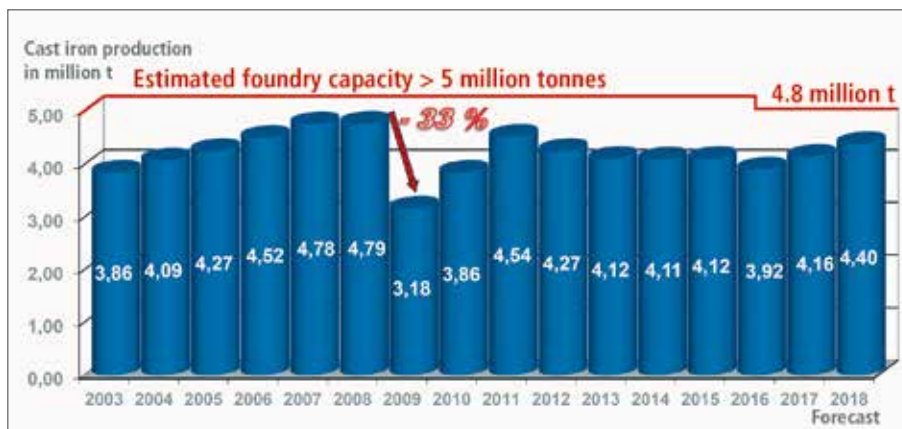
One thing which is evident is the Asiatic dominance, where in particular the Chinese foundries will become an even closer neighbour to Europe as a result of the massive drive to develop the “New Silk Road”. So China is investing almost 1 billion dollars in the trade routes of the New Silk Road to Europe and Africa [2].

The business climate of the foundry industry

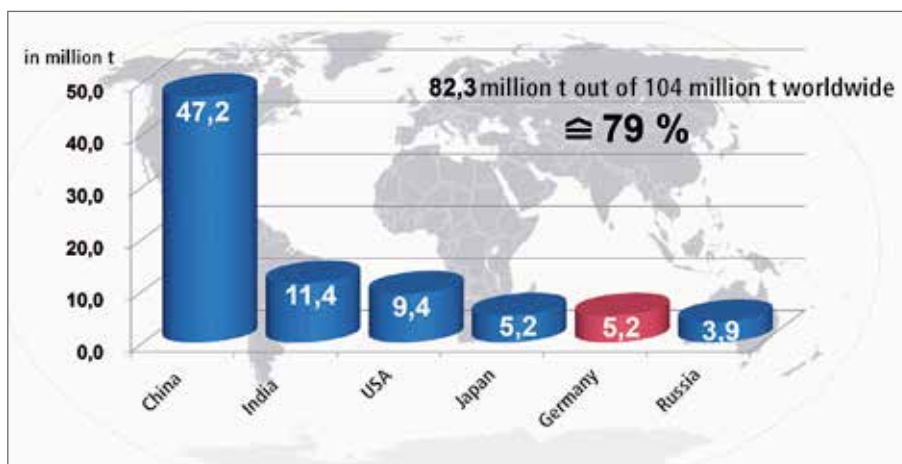
Business performance in 2018 shows a mixed picture for German foundries. While non-ferrous materials (NF), and in particular aluminium and aluminium alloys, record a slight decline, due to a restrained demand for automobiles, by contrast the demand for iron, steel and malleable cast iron (Fe) continues to increase.

Fortunately, each of the three main consumers of cast products – vehicle construction, machine construction and other cast metal applications – contributes to the forecast volume growth of 3% at around 4.35 million tonnes in 2018.

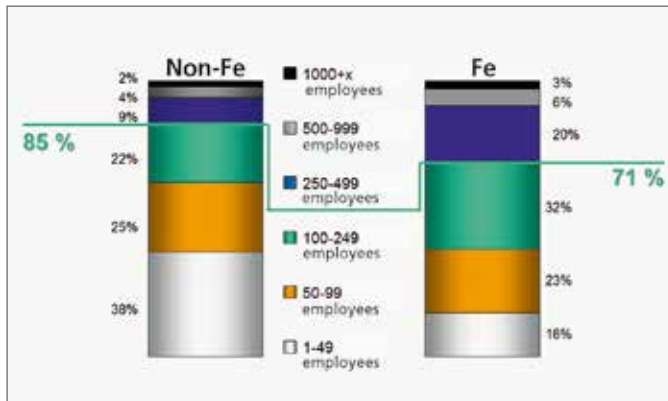
In summary, one can see from the production statistics that, after decline and stagnation in the period 2012 to 2016, the iron, steel and malleable cast iron production continuously increases again.



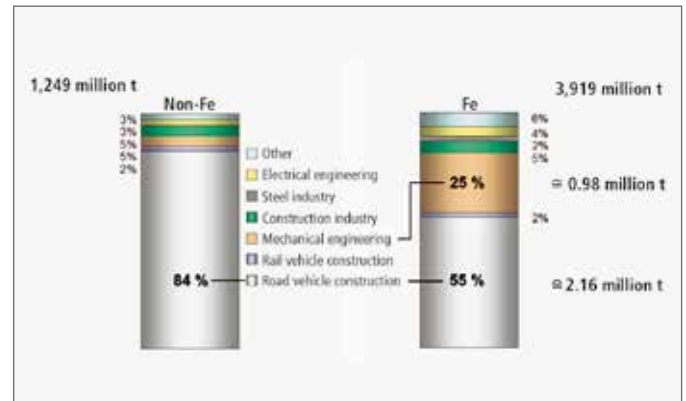
Production trend for German iron foundries [1].



German ferrous and non-ferrous production – 5th in the world (source: BDG).



Size structure of German foundries [1].



Sales structure 2016 [1].

On the structure of the German iron foundries

In 2017, German iron, steel and malleable cast iron foundries, with approx. 42,000 employees, generated total sales of more than 7 billion euros in 240 production units. Hence the average turnover amounts to 29 million euros per foundry with an arithmetic average of 175 employees.

A glance at the structure of business sizes for German foundries clearly shows that 71 % of the iron, steel and malleable cast iron foundries and 85 % of the non-ferrous foundries have up to 249 employees. Hence they pretty much epitomise the German mid-size sector. In particular, these medium-sized operations increasingly have to contend with problems in their economic environment. This can be for different reasons depending on the sector.

To a not inconsiderable extent, there are cross-industry changes in the framework conditions for the establishment and operation of industrial locations to which the large corporations can react more easily, but which can place a heavy financial burden on the medium-sized foundries.

Among these are:

- altered environmental requirements for production locations
- escalating approval procedures
- increased costs for energy supplies and constantly increasing formalities when applying for the special equalisation scheme and
- highly fluctuating raw materials prices

An example of changing environmental requirements is the amendment of the technical instructions on air quality control (TA Luft), the central immission control provisions and basis for approval for more than 50,000 industrial systems. To be newly adopted in TA Luft is the odour pollution control guideline. One can imagine that foundries which, at the time of their establishment, were still built in the open country away from towns and cities and are today surrounded by the urban environment with its different usage scenarios may be particularly affected by the change.

The customer structure of iron foundries

The customer structure of iron foundries is dominated by road vehicle and machine construction. In 2016 80 % of all iron, steel and malleable cast iron castings produced went to these sectors alone. The cast iron production of

EADIPS FGR member companies (pipes, fittings and valves) come under the categories Construction and Other. These sectors overall amount to a proportion of 11 % or around 430,000 tonnes a year. For many decades the pipe and pipe fitting production was explicitly identified, for the last time in 2003 with 231,000 tonnes a year, of which 180,000 tonnes (!) or 62 % were exported.

Since 2004, the law currently applicable for statistics for federal purposes unfortunately no longer allows for the separate disclosure for pipes and pipe fittings.

Outlook

As already described in the section on the structure of German foundries, there are

- altered environmental requirements for production locations
- escalating approval procedures
- increased costs for energy supplies and constantly increasing formalities when applying for the special equalisation scheme and
- highly fluctuating raw materials prices

which on the one hand weigh on the location and operation of the predominantly medium-size structures of iron foundries.

On the other hand it becomes apparent that, because of climate change, significant changes to the general underlying economic conditions need to be politically initiated. Above all, the reduction of CO₂ emissions and the increase of resource efficiency are at the focal point for the European Commission, which, in the large European internal market, sees an important field of action with which global problems are most likely to be solved.

So, even though there are no generally applicable procedures for determining this available as yet, in environmental aspects are already being enquired into as a product feature in product standards for the construction sector. There will possibly be rules in this area in the future for the awarding of public buildings contracts in which the eco-balance of building products will play a decisive role.

For the last few years, the German Federal Ministry of the Interior, Building and Community has been holding a round table for resource efficiency. It acts as a general information and transfer platform for different initiatives and encourages the networking of players in the building sector. The round table has since been meeting every six months and is currently accompanying developments and progress in the area of resource efficiency in the building trade. A central theme here is the sector-specific and appropriate representation of resource efficiency in this sector [3].

At the meetings of the round table, ongoing reports are made on research and development projects on the subject of "building materials recycling". The reuse of building materials is usually associated with a reduction in quality parameters, so in these cases it is a question of "downcycling".

Cast components used in the building trade, such as cast iron pipes for water supply, wastewater disposal, drain castings etc. can be 100 % recycled even after decades of problem-free use without any deterioration in their material properties. The recovery of the metallic raw materials has no negative impact on the natural world. Therefore the technical conditions for resource-friendly building products are basically met when it comes to cast iron.

In addition, the foundry industry is developing processes which aim at the complete recycling of the foundry sand.

Cast iron initiative

Basically, regional, national and EU institutions welcome the expertise of specialists who are in a position to support political processes which are technically justified on the basis of robust facts. This is the reason why EADIPS FGR, as the European association of ductile iron pipe system manufacturers, is looking to form a "Cast Iron Initiative" with other European manufacturers and users of cast construction products. The aim is to get together and develop pan-European measures to meet the climate targets negotiated in Paris in 2015 using construction products manufactured according to resource-friendly standards.

European producers, users and associations are warmly invited to collaborate in the "Cast Iron Initiative".

Keywords

Market monitoring, German foundry industry association (BDG), resource efficiency, casting production, business climate, structure, cast iron initiative

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Authors

Mario Mackowiak

Senior Advisor
Keulahütte GmbH
Phone: +49(0)171 4268821
mario.mackowiak@keula.world

Manfred Künze

Chairman of the Board
of EADIPS FGR

Christoph Aigner

Vice Chairman of the Board
of EADIPS FGR

EADIPS®/FGR®
Doncaster-Platz 5
D-45699 Herten
Phone: +49(0)2366 9943905
info@eadips.org
eadips.org

Sustainably superior!

Ductile iron pipe systems from European production

Technically superior

the material is strong	→	allows operating pressures up to 100 bars
effective external protection	→	shields against mechanical and chemical attack
static load-bearing capacity	→	allows very high stresses in the transverse and longitudinal directions
joints	→	allow operating pressures up to 100 bars; are resistant to root penetration
ductile iron	→	is non-combustible
installation	→	is possible with no special equipment
restrained joints	→	allow very high tractive forces and are therefore ideal for trenchless installation
the material has superior properties	→	which allow special applications in mountainous regions and for fire-fighting pipelines, snow-making systems and hydroelectric power stations

The technical performance of ductile iron pipe systems ensures the highest safety and reliability in all areas of the water industry!

Economically superior

push-in joints make for highly productive installation	→	reduces labour costs
no welding needed	→	reduces labour costs
installation in all weathers	→	reduces labour costs
sand bedding often not required	→	reduces materials and logistics costs
concrete thrust blocks not needed when joints are restrained	→	reduces materials and logistics costs
joints can be deflected angularly	→	saves on fittings
wide range of fittings and valves available so no need for specials	→	reduces materials and logistics costs
extremely low damage rates	→	reduces operating, energy, repair and maintenance costs
operating life of up to 100 years or more	→	keeps renovation budgets to a minimum

Investing in ductile iron pipe system pays for itself in low installation and operating costs with, at the same time, an extremely long operating life!

Environmentally superior

impermeability to diffusion	→	safeguards drinking water in all soil and installation conditions against environmentally damaging hydrocarbons and the groundwater when sewage is being transported
linings approved to food hygiene standards	→	ensure hygienic and environmentally safe transport of drinking water
scrap as the raw material	→	minimises the consumption of primary and fossil raw materials and reduces CO ₂ emissions
ductile iron can be recycled	→	saves resources for present and future generations
low expenditure on maintenance and repair costs over a long operating life	→	avoids waste, minimises the consumption of resources and reduces CO ₂ emissions

Ductile iron pipe systems can be shown to produce true sustainability!

Jürgen Rammelsberg and Christoph Bennerscheidt

University Lecturers Conference in Koblenz and Wetzlar

Ductile iron pipe systems: operation, climate change and digitalisation

Under the motto Operation, Climate Change and Digitalisation, the University Lecturers Conference of the German association for the promotion of information for university lecturers in the construction industry (FIHB) took place on 19 and 20 February 2018. FIHB and EADIPS FGR were the guests of Duktus (Wetzlar) GmbH & Co. KG and Koblenz municipal drainage. 15 university lecturers, a number of Koblenz municipal drainage employees and the employees of Duktus (Wetzlar) GmbH & Co. KG took part in an exchange for presentations, an excursion and a works visit followed by a technical demonstration on the subjects mentioned above.

Lecture programme at Duktus in Wetzlar

The University Lecturers Conference started off in the training rooms of Duktus (Wetzlar) GmbH & Co. KG with a welcome speech by **Prof. Marc Illgen** for the FIHB and Mr. **Friedrich Greiser** for Duktus (Wetzlar) GmbH & Co. KG. Then the presentation event began with expert moderation by **Dr. Jürgen Rammelsberg**.

In the presentation by the spokesman for the EADIPS FGR Digitalisation working group, Mr. **Frank Endreß**, entitled "Digitalisation permeates the water industry: collaboration between manufacturers, researchers and operators with respect to ductile iron pipe systems", he described the current areas of activity with a focus on water supply. For years now there have been discussions about the replacement of conventional meters with digital or smart meters in buildings to record the



Dr. Jürgen Rammelsberg welcomes Frank Endreß before his presentation on Digitisation of the water industry.



Hans-Jörg Schulz (left) outlines the expensive and time-consuming cleaning of the two culvert pipelines beneath the River Mosel. Tim Krüger (right) explains the technology of the inspection system used and its results.



consumption of water, gas, power and heat. However, so far these have only been comprehensively implemented in individual cases. On the one hand concerns about security and the fact that any added value for customers and operators cannot as yet be forecast seems to be blocking their use. On the other hand, with smart water meters for example, leaks in the domestic installation could be recognised more quickly and subsequent damage, such as damp walls

with the formation of mould would be minimised. Digitalisation for water supply is therefore still in its infancy. The clear and standardised identification of water supply components (pipes, fittings and valves) is a first step in supporting the process from production to the trader and the installation company and finally to the operator.

The EADIPS FGR Digitalisation working group has set itself this task; an identification system is in the process of being prepared.

There was then a report by **Hans-Jörg Schulz** (Koblenz municipal drainage) and **Tim Krüger** (8 SEAS consulting engineers – water + energy) on the preparation for and the results of the inspection of a wastewater culvert under the River Mosel at the “Deutsches Eck” in Koblenz after 44 years of operation. 70 % percent of the wastewater of the city of Koblenz is transported to the central treatment plant through two DN 800 and DN 1250 ductile cast iron wastewater pipelines with cement mortar lining (DN 800) or epoxy lining (DN 1250). Since the upper and lower heads of the accessible culvert were in need of renovation, it was first necessary to determine the state of the two culvert pipelines. This was uncharted territory for the Koblenz municipal drainage service: first of all the culvert pipes, which had been full of wastewater for 44 years, had to be intensively cleaned; this was the most time-consuming part of the project. Then, for the first time, the pipes of a wastewater culvert were examined for corrosion using **SLOFEC™** (Saturation **LOW**

Frequency Eddy Current) technology with great success: even after 44 years of continuous operation, strong currents and flooding, both of the ductile cast iron culvert pipelines only showed slight corrosion along the whole of their outside: at the “foreshore”, most areas were detected as having only slight local inhomogeneities (weak corrosive attack); it was only at the start of the inspection run, close to the pump house (lower culvert head) that areas of more severe inhomogeneity had formed. On the riverbed no damage at all was found on the inside and outside of the pipes, in other words the pipe wall is unchanged after 44 years of operation!

Even before the beginning of the presentation event, Messrs Bauer and Schulz from Koblenz municipal drainage had pointed out that the level of the Rhine is rising and the planned inspection of the culvert under this river might possibly have to be brought forward. And that is just what happened. With the rising level of the Rhine firmly in mind, the university lecturers and the Koblenz municipal drainage employees started out on their excursion by bus to Koblenz.

On the East bank of the Rhine, the works manager from Koblenz municipal drainage, Bernhard Mohrs, and the area manager Hermann Bauer were already waiting to greet the group at the open approach to the walk-in Rhine culvert. The underground culvert connects the Ehrenbreitstein bank of the Rhine with the Altstadt bank. Mr Mohrs told them that the Rhine culvert was driven at the beginning of the 1980s as a tunnel according to mining practice and then lined with a concrete shell. After that, among other things, the ductile iron pipes for fresh water supply and wastewater disposal were installed. The walk-in Rhine culvert is 370 m long and it is approximately 16 m beneath the river bed. Also the Rhine culvert is due to be renovated in the coming years. Mr Mohrs emphasised that the university lecturers’ conference along with the inspection of the Rhine culvert may be used in the technical exchange regarding the various upcoming renovation measures.

After that, the university lecturers and the Koblenz municipal drainage employees were led down a roughly 30 m long vertical shaft into the concrete-lined tunnel.



Works manager Bernhard Mohrs (extreme right) and Hermann Bauer (to the left of him) welcome the university lecturers on the “Ehrenbreitstein” side of Koblenz.



The group of university lecturers before entering the Rhine culvert on the Ehrenbreitstein side of Koblenz. The inner city of Koblenz is in the background.



The university lecturers as they immerse on the East side of the Rhine.



Ductile iron pipes inside the Rhine culvert.



The climb out from the culvert on the West side of the Rhine.

This enabled the university lecturers to get their own impression of the structural and safety-related tasks which await the Koblenz municipal drainage people.

On reaching the West bank of the Rhine, the opportunity was taken to inspect the freshly overhauled upper head of the Mosel culvert with the new solids macerator. Prof. Kirschbauer then invited the group to a seminar room at Koblenz University so that they could catch up on the planned presentation by **Christoph Benerscheidt** on “The sponge city principle – from pipe-soil-systems to soil-pipe-systems – solutions with ductile iron pipe systems”. As a possible measure for adapting to the effects of climate change, the use of the pipeline trench to store rainwater and as space for roots has been envisaged, naturally making use of the

“root penetration resistance of the push-in joint” and the “robustness” properties of the cement mortar coating of ductile iron pipes.

After enjoying an evening meal together, along with an exchange of technical ideas, the group went back to Wetzlar.

The next day of the event started early and focussed on cast iron as a material, the production of ductile iron pipes and the properties of the pipe system. Ductile iron pipe systems are almost 100 % produced from scrap. This resource-friendly recycling of raw materials was illustrated in the presentation by **Dr. Tobias Hoppe**. On this subject he outlined the current process adopted by cast iron pipe system manufacturers in order to optimise the production process in terms of energy. In the context of the subsequent works visit, the university

lecturers and the Koblenz municipal drainage employees were shown the individual processes involved. Starting with pipe production along with tightness testing, application of the zinc coating, lining with cement mortar and then final coating, all the production stages in the current operation were presented. Some production workers also took time to answer questions on the spot.

Following the works visit, the guests of Duktus went along to the testing hall for some practical demonstrations. The easy assembly and locking of a BLS® restrained push-in joint as well as its unlocking and dismantling were demonstrated. The test for checking the impact strength of the cement mortar coating and its removal on a pipe cut from the standard 6 m length pipes was also part of the demonstration programme.



"Sponge city" presentation at Koblenz University.



Dr. Tobias Hoppe during his presentation on resource efficiency in the production of cast iron pipes.



One-to-one discussion with an employee of the host company.



Demonstrating the drop test for checking the impact resistance of cement mortar coatings.

During a lunchtime snack together the informal chat continued between the university lecturers and the other participants, during which they talked over the many and varied impressions they had during the successful seminar. Particular attention was given to the combination of practical inspection on the visit to the Rhine culvert, the reports of network operators and measurement engineers as well as the vivid reports by the cast iron pipe experts about their latest developments such as the sponge city principle and the resource efficiency of ductile iron pipe systems.

Authors

Dr. Jürgen Rammelsberg

Christoph Bennerscheidt

EADIPS®/FGR®
 European Association
 for Ductile Iron Pipe Systems/
 Fachgemeinschaft Guss-Rohr-
 systeme e. V.
 Doncaster-Platz 5
 D-45699 Herten
 Phone: +49(0)2366 9943905
 c.bennerscheidt@eadips.org
 j.rammelsberg@eadips.org
 eadips.org

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University Lecturers Conference,
 Mosel culvert, resource efficiency,
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Andreas Chladek and Uwe Hoffmann

Long pipe relining in Magdeburg

Replacement of the 120 year old DN 700 grey cast iron drinking water main in Halberstädter Straße

The city of Magdeburg can look back on a truly complex history: It had its beginnings in the years 805 to 965, when the first German emperor of the Holy Roman Empire, Otto the Great, was crowned and declared Magdeburg to be his favourite palace; the gothic cathedral is his last resting place. From what was once an episcopal city, then a Hanseatic city, centre of the reformation and all but destroyed in the Thirty Years' War, at the beginning of the 18th century Magdeburg was built up to be the strongest fortress in Prussia. After the almost complete destruction in the Second World War, Magdeburg was quickly promoted to the status of a GDR district city and since 1990, with around 240,000 inhabitants, it has been the state capital of Saxony-Anhalt.

The drinking water supply for Magdeburg comes from the idyllic Colbitz-Letzlinger Heide (a heath 30 km to the North of the city). This is not only the largest continuous area of heathland in Central Europe but is also the largest uninhabited region of Germany. Beneath this unspoilt nature there are extensive reserves of groundwater from which the excellent Magdeburg drinking water is taken.

Renovation with a sense of proportion

The planning, construction and operation of the 1,235 km long drinking water network (820 km of water mains and supply distribution pipelines plus 415 km of domestic service pipelines) are down to SWM Städtische Werke Magdeburg GmbH & Co. KG. In addition, SWM operates the power, natural



The 2 to 4-lane Halberstädter Straße with its wide pavement area, cycle way, parking strip, trees, tramway and bus traffic before the start of the renovation work.



After 120 years of operation, the DN 700 grey cast iron pipeline is in a very passable state of maintenance.

gas, heat and wastewater sectors for the state capital. Close to half of the drinking water mains and supply pipelines for Magdeburg consist of cast iron pipes which, for the majority, have been in operation for more than a hundred years. The gradual and constant ageing process results in damage scenarios, particularly corrosion and especially in very old sections of pipeline, which necessarily require renewal or renovation. These renovation and/or renewal measures – principally of

the important large water mains – are being carried out by SWM responsibly and successively as and when the financial situation allows.

In the context of these maintenance measures, in the Summer of 2018 SWM started on a roughly 1,000 m long section, renovating the main drinking water pipeline in the Halberstädter Straße between Wiener Straße and Kroatenweg.

An old pipeline in modern surroundings

The key data for this existing pipeline are as follows:

Year of construction:	1897 and in operation ever since
Material:	grey cast iron (GG)
Nominal size:	DN 700
Pressure stage:	PN 10
Condition:	ageing damage as a result of spongiosis and increasing incrustation
Location:	beneath the pavement
Depth:	on average at approx. 2 m

The Halberstädter Straße is a major and busy arterial road running North-East to South-West with tram rails, two to four traffic lanes, bus traffic, cycle ways and wide pavements which are lined with shops, cafés and restaurants. Also there is an extensive stand of old trees in the immediate area of the drinking water pipeline to be renovated. So it was important to take account of traffic and environmental technology concerns

as well as obstructions/incursions for shops and residents and keep these to a minimum. In the context of approval planning there was comprehensive coordination with the Magdeburg city authorities (among others the road closure committee and civil engineering office) as well as the urban green spaces and cemeteries department regarding tree protection concerns. Also numerous on-the-spot discussions with the resident businesses both before and during the construction work by the contracting company meant that the work was able to proceed more or less without problem.

Decision in favour of the tried and tested

The planning done the year before by SWM was agreed with the city of Magdeburg, the existing utility operators and the Magdeburg transport companies among others. As had already been considered and implemented in other completed renovation projects, this provided for a reduction of the pipe diameter from DN 700 to DN 400 as a result of years of declining or static water consumption. After experiences in recent years, when renovation measures were being continuously carried out on old grey cast iron pipelines in the city, once again after cleaning and after camera inspection the existing pipeline did indeed show damage (incrustations, risk

of pipe ruptures), but even after 120 years of operation was nevertheless in a passable state of preservation.

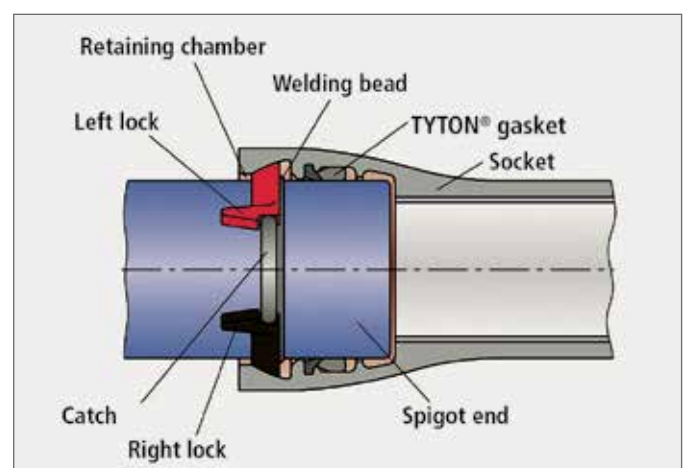
It was therefore obvious, considering these underlying conditions, the nature of the area surrounding the worksite and the corresponding economic and ecological considerations, that the renovation should be done mainly using a trenchless technique. In some place however, depending on constraints, the open trench technique would have to be adopted as well, above all to incorporate fire hydrants, branches, connections and sets of valves in the pipeline. In these cases, a reduction in the minimum depth of pipe cover from approx. 2 m to 1.20 m was specified.



From time to time it was necessary to integrate valves and hydrants ...



... as well as branches and connections by open-trench installation.



The BLS® restrained push-in joint.

So, in the end, SWM opted for the long-pipe relining process (in accordance with DVGW worksheet GW 320-1) for 915 m out of the total of around 1,000 m of DN 700 grey cast iron pipeline using

- DN 400 ductile iron pipes, standard overall length 6 m
- wall thickness class K 9
- pressure stage PN 10
- BLS® type positive-locking and restrained push-in joints
- cement mortar lining and
- a zinc-aluminium coating (400 g/m²) with a finishing layer of blue epoxy resin (EN 545)

The last of these features was decided upon for several reasons: in order to reinforce the galvanic protection effect a 15 % proportion of aluminium is added to the zinc to produce an alloy. In this way, and by increasing the total mass of zinc as compared with the standard zinc coating (200 g/m²), the result is an additional improvement in the technical service life to be expected. Also, the pipes require this coating if the annular space between old and new pipe is filled.

For the renovation of smaller sections, pipes in different materials and dimensions have been used.

Execution: precise, safe and effective

In Spring 2018, after around a year of planning, the renovation project was commenced in two phases in terms of both location and time:

- 1st phase: Halberstädter Straße from Wiener Straße to Ambrosiusplatz and
- 2nd phase: Halberstädter Straße from Ambrosiusplatz to Kroatenweg

Construction pits

Because of the route of the existing pipeline, the valves installed and because of changes to the pulling-in sections (it was planned to have pulling-in lengths of up to approx. 300 m), construction pits (for both installation and pulling-through) were excavated in the pavement area of Halberstädter Straße at a distance of 150 to 280 m. The pits were approx. 2.5 m wide, 8.5 m long and, depending on the depth of the existing pipeline, between 2.0 and 2.5 m deep on average. For pulling in the pipes, a Grundoburst 800 G bursting rig from Tracto-Technik GmbH & Co. KG was used which is driven hydraulically and has been developed for the static burst-lining process. Tractive forces of up to 80 tonnes can be achieved with this rig.

Pipe-pulling

The old DN 700 grey cast iron pipeline was first mechanically cleaned and then inspected by camera. The new 6 m long DN 400 pipes in ductile cast iron (GGG) were pulled in by an experienced team from Ludwig Pfeiffer GmbH & Co. KG according to the handling and installation instructions for long-pipe relining using the pulling process. The new pipes were aligned in the construction pit in each case and the BLS® push-in joints including their protection were assembled with a sheet steel cone sleeve. Using the bursting rig, the pipe string was then pulled 6 m into the old pipeline in each case, dragging on the sheet steel cone.

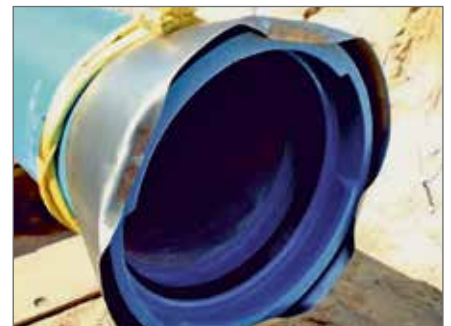
With reference to the traction forces to be expected for pulling in the pipes, SWM defined the requirements quite clearly. In advance and on the basis of their experience, their specialists estimated the traction forces, with obstacle-free progress, to be at



Pulling the new pipe into the existing old pipeline using the pull-in technique.



The pipe-string was pulled 6 m into the old pipeline in each case, dragging on the sheet steel cone.



Sheet-metal cone to protect the pipe socket during the pulling-in process.

least 6 tonnes (60 kN). With a risk loading of 4 tonnes (40 kN), the planning was based on pulling-in forces of approx. 10 tonnes (100 kN). During the work, traction forces of up to 7 tonnes (70 kN) were determined.

The effective speed of pulling-in depends on a number of factors: these include setting up the bursting rig, assembling the rods, assembling and dismantling the traction head, assembly times for installing the pipes and the actual speed of pulling in the pipes. Against this background, it can clearly be seen that the time required for long pulling-in sections is more favourable than for short ones.

In order to get a rough idea of the effective pulling-in speed, a section with a pulling-in length of 200 m can be considered as an example, without the pipe cleaning. For the installation and removal of the bursting rig, the assembly and dismantling of the traction head, installation of the rods and the pulling-in of the pipes, just about 4 days were needed, working between 5 and 12 hours a day.

Finishing work

The annular space remaining between the old pipe and the new pipe was filled with an alkaline insulating material which, according to the requirement set by SWM, had to have a shrinkage/water separation after curing of less than 1 % by volume and a compressive strength of at least 1.0 N/mm² after 28 days.

The last stage of the work was the pressure testing of the new pipeline using the accelerated normal process according to DVGW worksheet W 400-2 with a test pressure of 15 bar and a test time of one hour as well as the subsequent disinfecting of the pipeline.

Sustainability aspects achieved

The careful planning and preparation of the project, the fine-tuning with respect to adjacent construction projects, diversion concepts, public transport requirements etc.

with the city of Magdeburg, the existing utility companies and the Magdeburg transport companies among others as well as the choice of material and installation processes resulted in a successful completion of the renovation project. Numerous aspects of sustainable construction are achieved here. The most important of them are:

economic aspects

- considerable reduction of civil engineering costs by the use of the trenchless relining technique (only intermittent excavations for construction pits, use of the existing route)
- reduced costs for restoring the pavement surface
- reduced restriction of traffic (traffic lane, public transport, diversions)
- minimised impairment of access to the shops
- fast and secure assembly of the BLS® push-in joints
- high rate of installation productivity with the BLS® push-in joints
- reduction of the existing pipe diameter (increasing the speed of flow and shortening the dwell time of the drinking water in the pipeline which avoid hygiene problems)
- a further long working life of more than 100 years

ecological aspects

- only intermittent excavations for construction pits
- minimising the stoppages of private transport
- short assembly times allowing fast progress of work
- food-grade lining of pipes
- high diffusion tightness protects the drinking water
- low servicing and maintenance expense
- no negative impact on the trees

technical aspects

- restrained joints allow for the highest tractive forces and are therefore best suited for long pipe relining
- pipes and joints allow for operating pressures up to 100 bar according to nominal widthsizes
- installation does not need special equipment

If, by the end of October 2018, all the documentation, from acceptance protocol to tractive force statements, has been handed over, SWM can tick off the Halberstädter Straße renovation for the next 120 years and get started on the next section.

Keywords

Long pipe relining, renovation, Magdeburg drinking water pipeline, reduction of pipeline cross-section, sustainability

Authors

Andreas Chladek

SWM Magdeburg
Städtische Werke Magdeburg
GmbH & Co. KG
Am Alten Theater 1
D-39104 Magdeburg
Phone: +49(0)391 587-2317
chladeck@sw-magdeburg.de
www.sw-magdeburg.de

Uwe Hoffmann

Duktus (Wetzlar) GmbH & Co. KG
Sophienstraße 52-54
D-35576 Wetzlar
Phone: +49(0)172 7221174
www.duktus.com

Volker Meyer

Time to harmonise hygiene requirements

EU-wide hygiene requirements for materials and products in contact with drinking water

All citizens of the EU are entitled to high quality drinking water. The same rules should apply for all materials and products in contact with drinking water. The revision of the Drinking Water Directive (DWD) happening at the moment offers a unique opportunity for determining EU-wide harmonised hygiene requirements aimed at this target.

Food-safe products and materials

Every day we drink water from the tap, shower and wash our hands without really questioning where the water comes from. Drinking water is taken from groundwater or surface water and continues on its journey to the consumer through a complex infrastructure of pipes, reservoirs, pumps, valves, water meters, water heaters, filtering devices, hoses, seals, water taps etc. All these products and the materials from which they are made – such as metal, cement, plastic, rubber, silicon – are important for the provision of high-quality drinking water.

Doing away with fragmentation

At the moment there are no EU-wide rules about the hygiene and safety of materials and products in contact with drinking water. Some member states have developed their own rules for this, others have none. This legal fragmentation results in different hygiene requirements which possibly lead to varying levels in the protection of human health. This not only affects consumers but it also means fragmentation within the EU internal market where companies have

to meet different national regulations when they want to export to different member companies.

Small and medium-sized enterprises (SMEs) in particular do not have the necessary means to deal with this and cannot afford to supply their products in other markets. Because of the complications in disseminating new developments to the whole of the EU, companies lack the incentive to bring innovative products with longer useful lives or lower leakage rates onto the market. The European Commission itself admits this, in that it states that the “current provisions are not working well and point to a long-term challenge for the provision of pure and healthy drinking water in the EU” [1]. Inertia in this situation is no longer acceptable.

Advantages of the internal market for SMEs

For the European Union the time is ripe for determining harmonised hygiene requirements for all materials and products in contact with drinking water. This is advantageous for public health, competitiveness and innovation: all consumers in the EU could enjoy the same high level of protection of human health and businesses in the EU – above all small and medium-sized enterprises – could reap the benefits of the internal market. The revised drinking water directive should put the European Commission in a position to adopt transferred or transposed provisions by means of which EU-wide hygiene rules [2] will be established for all materials and products in contact with drinking water.

Developing standards is not the answer

Other options do not achieve this aim. The proposal of the European Commission to develop standards under the Construction Products Regulation will not lead to harmonisation. A major part of products in contact with drinking water do not come within the area of application of the Construction Products Regulation: water heaters, water meters, pumps, water filtration equipment, hoses, seals would be excluded from harmonisation. Hence a significant loophole in the law and a legal vacuum would be produced. Moreover, standards for construction products are unable to harmonise hygiene requirements: generally speaking, standards define the test methods which have to be used for checking products, but they do not determine any hygiene requirements for which the materials and products should be tested [3]. There is no harmonisation if the same test methods are applied with differing national requirements.

Taking the opportunity to harmonise

The “European Drinking Water” industry association is calling on politicians to take advantage of a revision of the drinking water directive to harmonise materials and products in contact with drinking water. An ambitious solution is within reach and is backed by a wide range of stakeholders. The European Parliament [4] and a large majority of member states [5] support harmonisation under the drinking water directive, as do the drinking water suppliers [6] and consumer organisations [7]. The

time for harmonisation has arrived. Let us not allow this opportunity to pass.

About us

European Drinking Water (EDW) is a group of currently 30 European trade associations from the industry who are involved in the supply of products and materials which are used in the area of drinking water and have links with the drinking water suppliers within the European Union. This extends from the suppliers of raw materials to the manufacturers of pumps, water meters, pipes, valves, fittings, water taps, water purification, water heaters, catering facilities, seals etc. and all types of materials such as elastomers, metals, plastics and so on. The group is open to any industrial association with regard to applications in contact with drinking water.

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Author

Volker Meyer

Chairman of the European Drinking Water Industrial Alliance (EDW)
Marienburger Str. 15
D-50968 Köln
Phone: +49(0)221 3766851
meyer@figawa.de

Jörg Meier

100 new drinking fountains for Berlin

Kaiser drinking fountains combat the plastic bottle

With the presentation of the “Blue Community” certificate on 23 October 2018 by Maude Barlow, world-renowned water activist, bearer of the alternative Nobel prize and initiator of the global water project, Berlin has officially received the “Blue Community” designation. With this certificate, presented to the Berlin Senate, the City subscribes to the principles of a “Blue Community”, thereby committing itself to the following four principles:

1. Recognition that water is a human right
2. Water services remain under the control of the public authorities
3. Drinking mains water instead of bottled water
4. Promoting partnerships with international partners

Blue Community Berlin – an exemplary initiative

Blue Communities – and after Bern and Paris, Berlin is the third “blue” capital of Europe – encourage the people within them to go back to drinking mains water. Within their own structures and operational processes are striving towards responsible handling of water and – as far as possible – use drinking water from the public water supply. Because: locally sourced mains water provided via the municipal drinking water network protects the environment. Mineral and table water, on the other hand, is filled into bottles and transported onto the street, requiring a thousand times more energy than is used for the supply of mains water from the drinking water network. In Berlin there are currently 48 drinking fountains



from which, between May and October in each case an average of 350,000 litres of nicely cooled water bubbles up from the city’s drinking water system. In addition there are 62 drinking water dispensers available in public administrative buildings.

But since, last Summer, weeks of tropical temperature prevailed, drinking water fountains have become ever more important. Berlin wants to instil the drinking of healthy, mineral-rich mains water even more strongly in public spaces and offer everyone in the city refreshment with drinking water as they pass by – quickly, free of charge and in an uncomplicated and environmentally friendly way. And, not least, to declare war on the waste mountains of plastic bottles!

With the resolution of the House of Representatives for the Blue Community on 22 March 2018, for the first time the State of Berlin is making one million euros available for a drinking water fountain construction programme over the coming two years. Distributed over the whole of the city, Berliner Wasserbetriebe, the water supply company for the city, will now be setting up a further 100 drinking fountains and water dispensers in addition to those already in existence.

Kaiser cast iron drinking fountains – reliefs tell a story

It is already 30 years since Berliner Wasserbetriebe installed drinking water fountains in the city. With the artistic blue Kaiser drinking fountains made of cast iron (designed by Siegfried Kaiser), which are constructed as constantly bubbling fountains, the special desire was to depict the “history of drinking water”: The basin of the fountain sits atop a column divided into five segments. Representations can be seen in relief on each of the sections of the column which show the process of turning groundwater into

drinking water: In the lowest segment there are aquifers with vertical groundwater wells while the relief above it shows the atomisation and aeration of the raw water at the waterworks. In the third segment we see the filtering of the water in the filter basin. The next

relief illustration shows a drinking water reservoir and a pump at the waterworks and then the branched network of pipelines with a hydrant and a valve, the cover of which can be seen on the pavement. A further image symbolises nature's water cycle with rain, bodies of water and groundwater. Groundwater is the raw material for Berlin's drinking waters.

The top of the column forms the bowl with a frame, a drinking spout and a catch basket. The drinking spout consists of a bronze head with a water nozzle lying deep in the body of the spout.

Manufacture and timing – in good hands

The contract for the construction of these lavishly designed Kaiser drinking fountains and their delivery went to Ludwig Frischhut GmbH & Co. KG from Pfarrkirchen in Bavaria, a subsidiary of the Talis Group.

After taking over, adapting and preparing the existing model for the Kaiser drinking fountain, which has been produced since 1985, the company, working together with Berliner Wasserbetrieben and the enamellers commissioned for the work, succeeded in producing the initial sample and receiving the go-ahead for this. After the challenging production of the individual cast iron components and their enamelling, finishing, preliminary assembly and final checking were carried out at the Ludwig Frischhut premises. This collaboration between workshops enabled the quality demanded by Berliner Wasserbetriebe to be guaranteed under one roof. Therefore the company is the main supplier for the "100 drinking water fountains for Berlin" project being promoted by the Berlin Senate.



Thirty fountains had already been supplied by the end of 2018 – quite a challenge as each individual segment and the bowl at the top were produced with hand-moulded castings requiring considerable manual effort. The other Kaiser drinking water fountains belonging to this project will be finished in the current year of 2019.

The employees of the "Kundenguss" section are very proud of this project: proud that, on the one hand, their work is visible and on the other hand that they have had an active part in shaping the image of Berlin, while usually their products perform their essential functions mainly in the background.

Keywords

Kaiser drinking water fountains in Berlin, drinking fountains, Blue Community, hand-moulded casting

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Further information on drinking fountains in Germany, drinking fountains in Berlin and on the Blue Community initiative can be found on the following Internet sites:

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- BDEW
- Trinkwasser Unterwegs

Author

Jörg Meier

Ludwig Frischhut GmbH & Co. KG
 Franz-Stelzenberger-Str. 9-17
 D-84347 Pfarrkirchen
 Phone: +49(0)171 8832213
 jmeier@talis-group.com
 www.frischhut.de

Hans-Jörg Schulz and Wilhelm Kelb

Inspection of a culvert pipeline after 44 years of operation

The Mosel culvert at the "Deutsches Eck" in Koblenz

History

The city of Koblenz lies at the confluence of the Rhine and the Mosel. A landmark of the city is the Deutsches Eck with the equestrian statue of the first German Kaiser, Wilhelm I, at the point where the Mosel flows into the Rhine. Because of this difficult topographical location of the city of Koblenz, difficulties arise both in the planning and construction and in the operation of wastewater facilities. Hence sewage disposal represents a particularly major challenge for the Koblenz municipal drainage services (SEK).

At the beginning of the 1970s, in the immediate vicinity of the "Deutsches Eck", one of the most important sewage structures in the city area was built: the Mosel culvert [1]. This takes about 70% of the Koblenz wastewater beneath the bed of the Mosel to Koblenz-Lützel and from there onwards via a wastewater pumping station to the central treatment plant after Koblenz-Wallersheim.

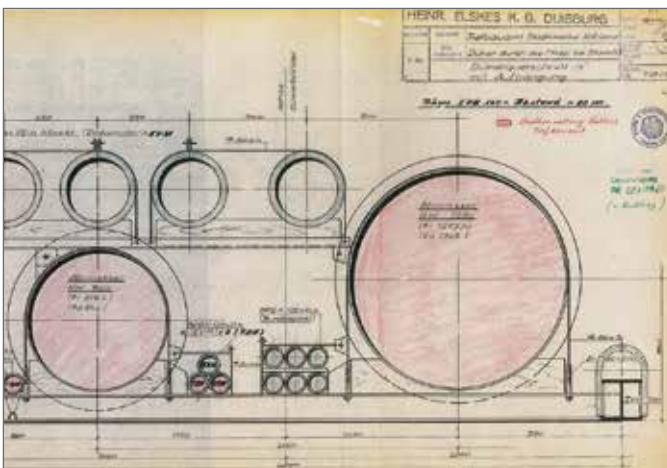
In the planning of the project, in addition to the demands for wastewater disposal, the requirements of the former municipal waterworks, the current power supplier Energieversorgung Mittelrhein AG and the former Deutsche Bundespost were also taken into account.

Therefore the Mosel culvert was planned as a package, consisting of two DN 800 and DN 1250 wastewater pipes, four NW 450 (PE) drinking water pipelines and six NW 125 (PE) cable conduits. Particular attention was paid to the material for the wastewater pipes. It was to meet the following criteria:

- resistance to domestic sewage
- absolute tightness of the pipe joints
- flexibility of the joints and the material, in order to take up subsidence in the area of the river
- resistance to abrasion
- possibility of installation using the pull-in process without disrupting shipping

According to [1], vitrified clay and concrete could not be considered "because of their weight". PE and PVC pipes were excluded "because, for the nominal sizes in question, expensive sheathing would be necessary against deformation". Ductile cast iron seemed to those responsible to be the most appropriate for the criteria required; above all at extremely demanding steep sections in the Koblenz city area, pipes in ductile cast iron had already proved successful.

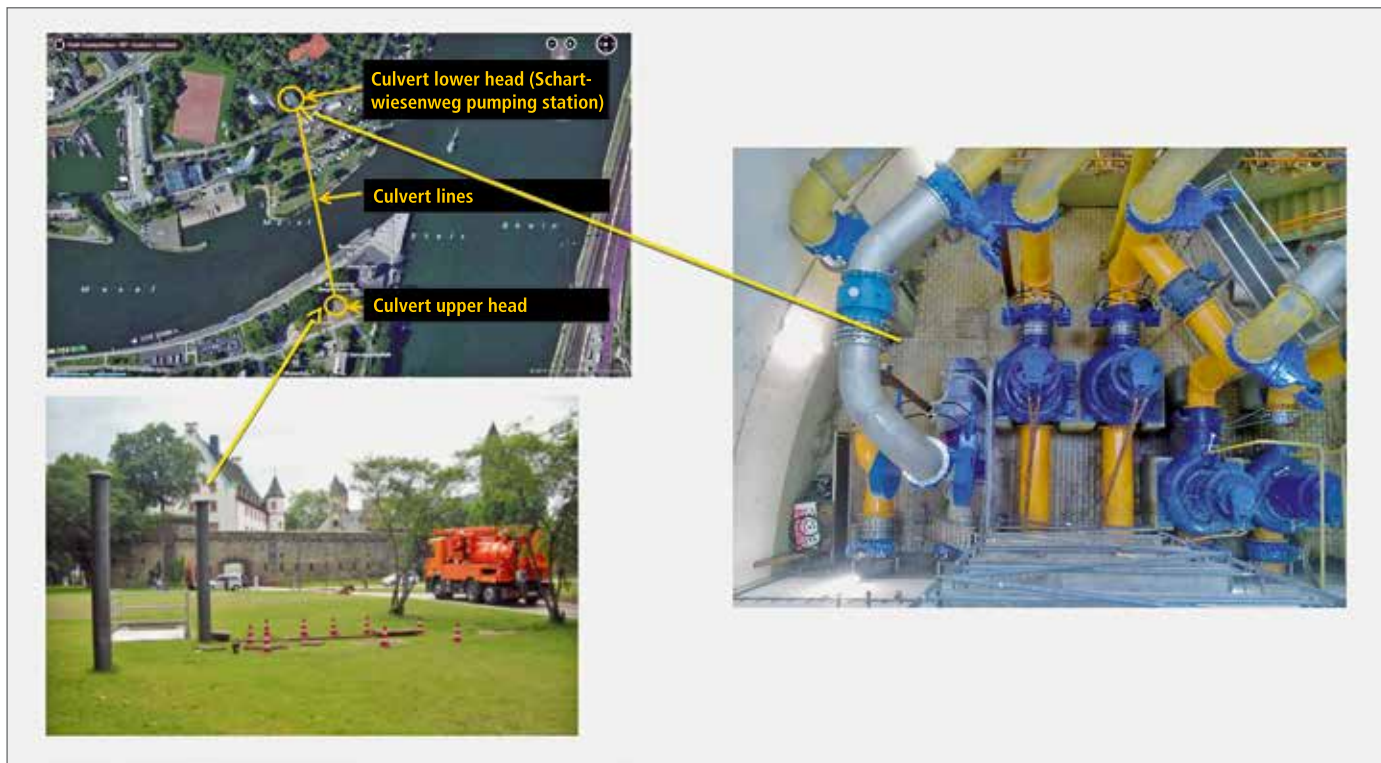
In order to increase the abrasion resistance and strength of the ductile wastewater pipes even further, in each case an internal coating was provided: The DN 800 pipes were given a 6.4 mm thick lining of special mortar and the DN 1250 pipes a lining with a 1 mm thick coating of epoxy resin because, for technical production reasons, a mortar lining could not be applied. The length of the culvert to be constructed from outlet structure to inlet structure is 294 m.



Culvert cross-section: top left four drinking water pipelines, below left the DN 800 wastewater pipeline, below right the empty pipes for the Bundespost and the DN 1250 wastewater pipeline.



Securing the pipes with steel frames and lowering them to the riverbed.



The culvert and its structures.

In order not to obstruct shipping in the area of the work, the assembly was divided into three sections: two of 119 m in each case and one of 56 m. These were assembled on a kind of building slip (as can be found in a shipyard), parallel to the landside route of the culvert. The pipes were secured with 4 m wide steel frames and lowered with the help of barges into the already prepared channel in the river bed. Pressure testing has already been done with part sections on land.

In addition to the culvert pipelines (two DN 800 and DN 1250 wastewater pipelines, four NW 450 drinking water pipelines and six NW 125 cable conduits) the culvert upper head and the culvert lower head (Schartwiesenweg pumping station) with its four rainwater pumps and four wastewater pumps also belong to the complex components of the culvert.

The reasons for the culvert inspection

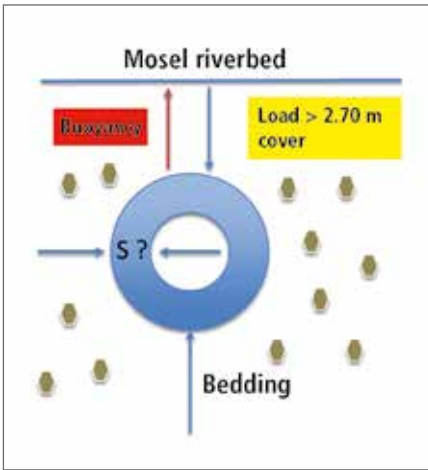
The legal basis for the inspection of the Mosel culvert was and is Annex 3 (§ 4) according to the Rhineland-Palatinate State regulation on the self-monitoring of wastewater plant, EÜVOA / SÜVOA, [2]. According to this

- “The correct working condition of sewers and wastewater pipelines is to be checked at least every ten years by means of optical inspections.
- In water and mineral spa protection areas, shorter periods apply in accordance with the generally recognised rules of the trade.
- For new or as-new sewers and wastewater pipelines, the first two repeat inspections after commissioning are to be carried out after 15 years in each case.”

Apart from the necessary evidence of the tightness of the culvert pipelines to be provided for the supervisory authority, the concrete

constructions in the upper head of the culvert were found to be in a critical state. The frequency of maintenance for the pumps in the Schartwiesenweg pumping station was seriously increased because of a build-up of wet-wipes. Clean-up measures here were therefore quite clearly urgent.

But as regards the overall construction of the culvert, the two culvert pipelines, DN 800 and DN 1250, were naturally also under discussion. Here the Koblenz municipal drainage services were faced with one quite decisive question with far-reaching consequences: Is the investment for renovating the adjoining structures of the upper and lower culvert heads including the pumping station still economical at all in view of the lack of knowledge about the condition of the two culvert pipelines which have been in operation for 44 years? And then: If the culvert should prove to be unfit for further use or no longer capable of renovation, definitive and quite different planning considerations would have to be



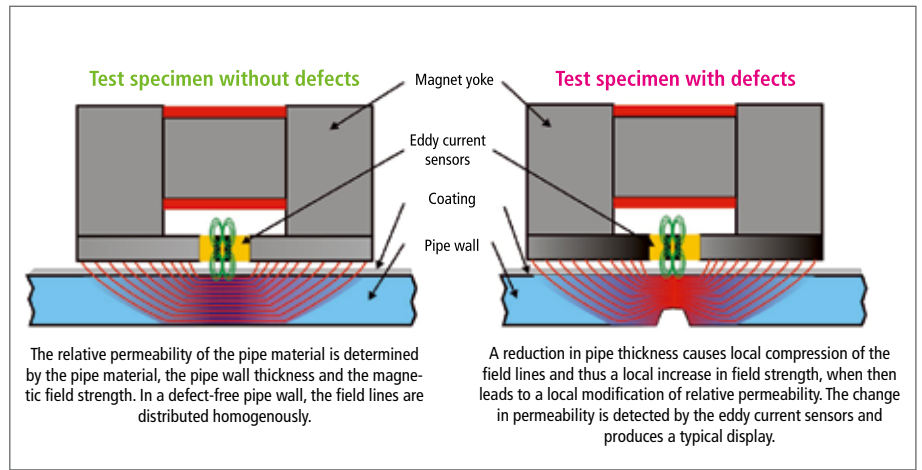
Unknown parameters: residual wall thickness s and the interplay of buoyancy and supporting forces.

explored. Therefore it was also necessary to evaluate the condition of the two culvert pipelines and to do this in the context of an inspection.

The prerequisites for inspecting the culvert pipelines

As the EÜVOA/SÜVOA regulations for the monitoring of sewers only require an optical inspection, the initial deliberations looked at a mutual cleaning of the culvert pipelines followed by conventional video inspection. To do this, a pipeline must always remain in operation in order to ensure dry weather flow. However, this type of inspection necessitates complete emptying of each pipeline in turn, which did not appear practicable.

A further prerequisite for optical inspection is a guarantee of buoyancy control. A regular sounding in 2014 did in fact show that there was a sufficiently high covering of the culvert pipelines, meaning that buoyancy control was ensured. Nevertheless, the officers of the municipal drainage service considered the risk of exposing the two pipelines to the interplay of buoyancy and supporting forces without knowledge of the remaining wall thicknesses after more



SLOFEC™ functioning principle.



Very time-consuming: intensive pipe cleaning by pig (for each pipe the team worked 24-hours-a-day for four days).

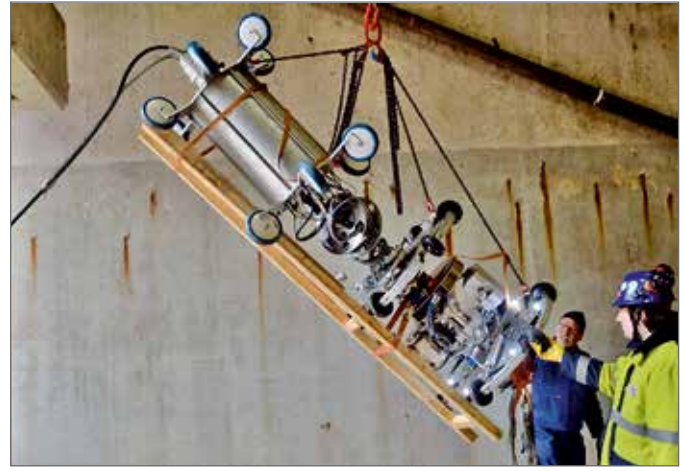
than 40 years of continuous operation as being too high. Hence, optical inspection was evaluated as being too uncertain and risky.

Limiting conditions for the inspection process

Therefore, as an optical inspection was obsolete, it was necessary to look for and find another solution. In order to gather and determine



The PLS type SLOFEC® internal pipe scanner.



Lowering the SLOFEC® scanner into the lower head of the culvert.

all facets of the problem as to what the inspection process needed to deliver, the officers of the Koblenz municipal drainage service (SEK) thought it wise to define the major limiting conditions for this first of all.

The inspection process should:

- function with the culvert pipelines complete full
- supply information on serviceability
- provide data on the remaining working life
- provide data on the condition of the culvert pipelines
- be able to be performed in an acceptable and calculable period

Requirements for the inspection system

Thus the sewerage department of the Koblenz municipal drainage service had defined the essential framework conditions for the inspection process. On top of this, an inspection process with particular features needed to be found. Together with the engineering company, Ingenieurgesellschaft für Wasser-, Abwasser- und Energiewirtschaft mbH Tuttahs & Meyer from Andernach, which was commissioned for the planning and tendering of the project, they then specified the requirements for the

inspection system to be selected, which almost exclusively related to the accessibility of the object to be inspected:

- The culvert pipelines are not designed for inspection by pig. There are no pig traps. The insertion of an inspection device has to be done at the lower head of the culvert.
- Access to the culvert pipelines is only possible from one end. The inspection system must allow bi-directional operation.
- The inside surface of the culvert pipelines is coated. The inspection system must be able to be used for checking the pipe wall through the coating.
- Thorough cleaning before the inspection is not possible. The surface may still present residues or deposits. Inspection must also be possible in the presence of low-level residues or deposits.
- The pipeline needs to be inspected in the filled state, whereby complete filling without air bubbles cannot be guaranteed. The inspection system must be able to be used regardless of the coupling medium under water and under atmospheric conditions.

The approach for the inspection

As a solution for the complex inspection of the two culvert pipelines, Ingenieurgesellschaft Tuttahs & Meyer proposed an inspection system which examines the metal piping system for corrosion by means of an eddy current using **SLOFEC™** (Saturation **LOW** Frequency **Eddy Current**) technology. Alongside other systems considered, it was only this one which proved to be practicable for this particular purpose.

SLOFEC™ is based on the technique of the eddy current process in which the area of the component being recorded is premagnetised and tested with relatively low-frequency eddy current signals. The magnetic field apply is disrupted by local instance of inhomogeneity in the pipe wall (e.g. the consequences of corrosion). And it is precisely this disruption which is displayed on the basis of the eddy current field induced at the same time. The eddy current probes applied, which are located between the poles of the magnets, are seamlessly joined together, thereby producing a close-meshed measuring range of the modular-based system.

The engineers from Andernach convinced the officers from the Koblenz municipal drainage service of the application and success

of this inspection technology which, until then, had only been used in industrial plant and so was being applied for the inspection of a wastewater culvert for the first time in Germany. The public call for tenders was then carried out for separate lots: culvert cleaning and culvert inspection.

Implementation

The contract for the cleaning was won by Norand Industrieservice GmbH from Löbnitz, the one for the inspection went to 8SEAS consulting engineers – water + energy from Nackenheim. 8SEAS commissioned the experienced company KontrollTechnik GmbH from Schwarmstedt, which specialises in inspection processes, to perform and supervise the work. This company had developed various types of SLOFEC® internal pipe scanners for inspecting underground pipelines in industrial plants.

Pipe cleaning

As the inspection system requires absolutely clean pipes, the first stage consisted of the intensive cleaning of the two culvert pipelines. Norand Industrieservice GmbH from Löbnitz needed four working days of 24-hour operations per pipeline in order to pull through the correspondingly large cleaning pig with a winch and hydraulics support.

The problem with wet-wipes is also worth mentioning here: during the pigging process, the wet-wipes were adhered to large surface of the pipe wall; only by using flushing nozzles could they be released from the pipe wall and then be sucked away. After complete cleaning the pipes were filled with clean water.

3D positional measurement

After the very time-consuming cleaning of the culvert pipelines, its XYZ position beneath the river had to be determined. To do this, 8SEAS consulting engineers under commission by the Koblenz muni-

icipal drainage service used 3D gyroscopic measurements with Duct-runner measurement technology.

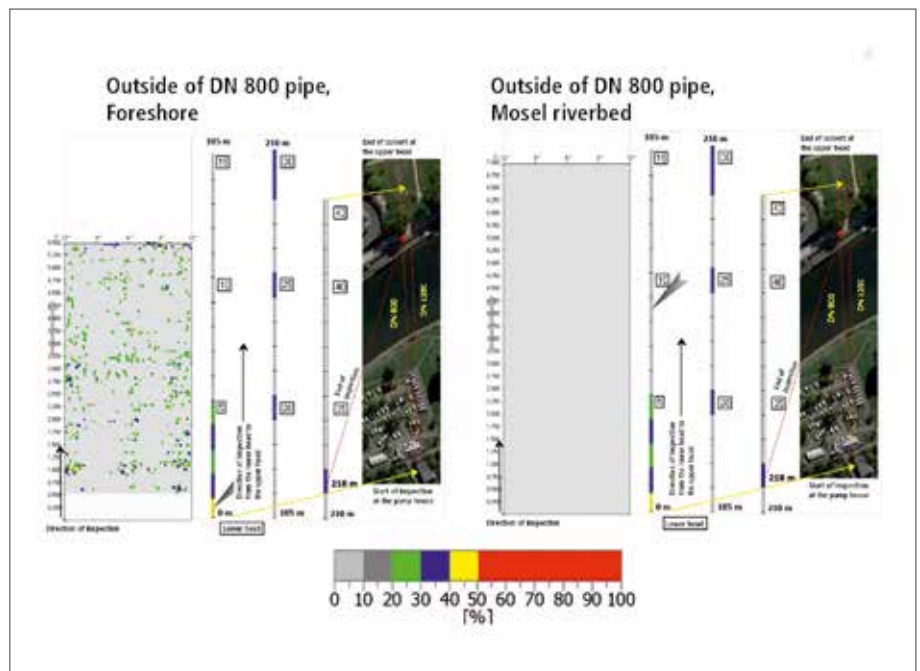
The sensors required for measuring the three-dimensional positional data, the energy supply and the data storage unit are integrated into the measurement probe. The sensors consist of gyrocompasses and accelerometers. At each measurement point, the changes in the direction and the speed are recorded. As this technology is not dependent on GPS technology it is particularly suited for use underground.

Inspection

The non-destructive inspection of the pipe walls was then carried out with the PLS type SLOFEC® internal pipe scanner. It started in the Schartwiesenweg pumping station in the lower head of the culvert, travelled through the culvert pipelines (DN 800 cement mortar lining, DN 1250 epoxy lining) and ended at the upper head of the culvert.



Positioning the scanners at the culvert opening.



Representation of measurement data and results for the DN 800 wastewater culvert.

The wired scanner was lowered into the culvert opening at a depth of approx. 15 m and then inserted into the culvert. The SLOFEC® scanner did not have its own drive system for this inspection but was winched through the culvert. For data recording purposes it was positioned in an axial direction by the winch, with the sensor head “pressed” against the pipe wall and moved circumferentially; the corresponding inspection section was 150 mm. After completion of a full circumference scanning by the rotating sensor unit, the scanner was pulled forward by a further 150 mm the axial direction and a new measurement started until the complete data recording across both culvert pipelines was finished.

Evaluation

The data recording and the analysis of the inspection delivered some surprising results: Even after 44 years of continuous operation, strong currents and flooding, the ductile cast iron culvert pipelines only showed slight corrosion along the whole of their outside: at the “foreshore”, most areas were detected as having only slight local inhomogeneities (weak corrosive attack); it was only at the start of the inspection run, close to the pumping station (lower culvert head) that areas of more severe inhomogeneity had formed. On the Mosel riverbed no damage at all was found on the inside and outside of the pipes, in other words the pipe wall is unchanged after 44 years of operation!

From the evaluation and analysis of the data obtained there was (and is) no need for renovation of the culvert as any significant impairment to wall thickness by corrosion and/or other ageing damage was able to be definitively excluded, even in the lower head areas of the culvert.

Prospects

The first testing system to be used in Germany for the inspection of a wastewater culvert, looking for corrosion using SLOFEC™ (Saturation LOw Frequency Eddy Current) technology had its premiere in Koblenz with great success. With the results showing the good condition of the culvert pipelines, the way was opened for the investment to renovate the dilapidated concrete structures of the adjoining culvert upper and lower heads and thus further long-term use of the culvert structure as a whole.

The renovation of the concrete constructions in the upper head of the culvert was finished in 2017 and the “Schartwiesenweg” pumping station in the lower head of the culvert is planned for renovation as from 2020.

Based on the experiences with the pipelines of the Koblenz Mosel culvert, for future inspections of this kind there is still a need for improvement on two points:

- because of the soiling matrix, an addition process should be used in support of cleaning by pig, such as the pulsed flushing process
- the inspection tool should be better protected against solids (the wet-wipes problem) for use in the field of sewage

The success of this culvert inspection is built not only on the sophisticated technology of the process but also on the boldness of all concerned, according to Ernst Ferstl, Austrian lecturer, writer and aphorist: “beating a new path means managing without signposts”.

Keywords

Mosel culvert, culvert inspection, pipe cleaning, SLOFEC® scanner, SLOFEC® process, ductile iron pipes

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Authors

Hans-Jörg Schulz

Eigenbetrieb Stadtentwässerung
Koblenz/Kanalbetrieb
Kammertsweg 82
D-56070 Koblenz
Phone: +49(0)261 129-4039
hans.schulz@
klaerwerk-koblenz.de
www.koblenz.de

Wilhelm Kelb

Kontrolltechnik GmbH
Im Laab 23
D-29690 Schwarmstedt
Phone: +49(0)5071 981511
w.kelb@kontrolltechnik.com
www.kontrolltechnik.com

Marco Nussbaumer

The intergenerational project “Circulago” of WWZ AG

Heating and cooling from the waters of Lake Zug

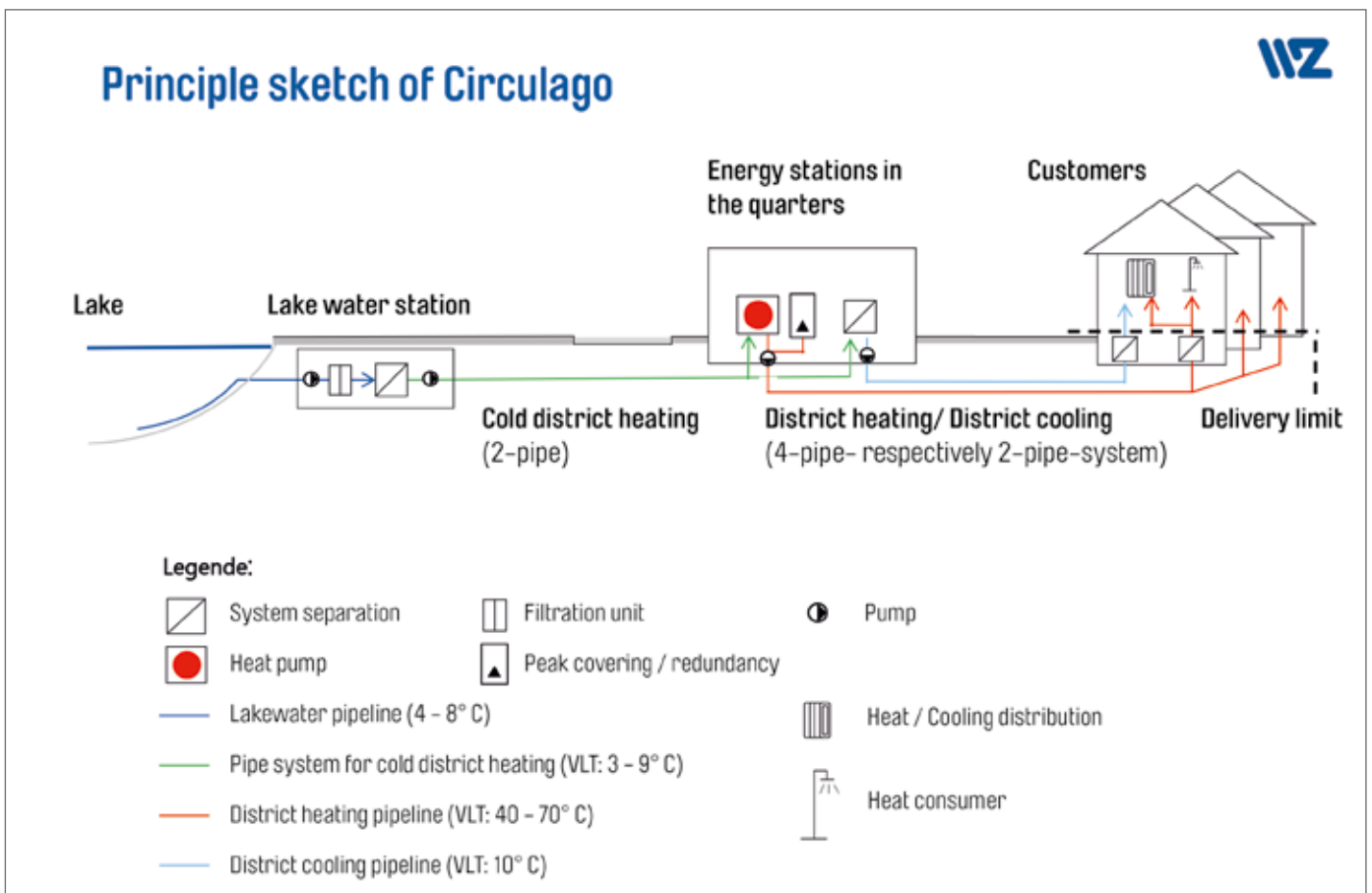
“Circulago” is a future-oriented project to supply the town of Zug and the southern part of Baar with environment-friendly heating and cooling energy derived from the water of Lake Zug. In 2011 the citizens of Zug voted “yes” to the so-called people’s initiative “2000 Watts for Zug” with the aim of developing the values of a 2000 Watt society in their town over the long term. In the pursuit of this aim, by the year 2050 the CO₂ emissions should be reduced to 2 tonnes per person per year and the primary energy consumption to 3,500 W.

In order to achieve these aims there are various renewal measures and improvements to and within buildings on the agenda of the town and its citizens.

In 2014 the town and canton commissioned a feasibility study which, among other things, was to determine the potential of lake water to cover the heating and cooling requirements of public and private properties. The feasibility study showed town and canton that the supply of the urban districts with heating and cooling

from lake water is possible. Lakes are like giant energy reservoirs and the position of the town directly on Lake Zug is therefore ideal.

“Circulago” is being planned, implemented and operated by Zuger utility company WWZ AG. The first buildings will be able to be connected up as early as the second half of 2019 and supplied with heating and cooling. The development is being done in stages.



Functioning principle in brief:

The lake water is transported through a pipeline to the lake water power station where its energy is transferred to a second, separate pipeline network. This cold district heating pipeline routes the energy into the district power stations where heat is produced by heat pumps and cold is directly transferred by heat exchangers. Heat and cold are then distributed individually to the connected buildings.

(Source: Robert Watts, WWZ Energie AG)

Ductile iron pipes for the "Anergy network"

With "Circulago", the town of Zug and adjacent districts will therefore be getting their heating and cooling supply from Lake Zug in the future. To achieve this, water will be collected from the depths of the lake and routed to the lake water power station. The energy of the lake water will be taken via a heat exchanger into a second independent circuit – the so-called "Anergy network" – which then connects with the urban districts.

TMH Hagenbucher AG was awarded the contract for this Anergy network to supply, in the first stage, around twice 1,000 m (flow and return) of DN 600 ductile iron pipes to EN 598 [1] with cement mortar coating and approx. twice 860 m DN 400 ductile iron pipes with protective epoxy finishing layer.

The DN 600 ductile iron pipes were pulled into the microtunnel with an internal diameter of 1.6 m by TPS Trenchless Piping Systems AG, which also belongs to the Hagenbucher Group, using mobile double pipe clamps specially developed for this application.

This microtunnel has a number of horizontal and vertical changes of direction. The restrained BLS® push-in joint of the pipes, with a diameter of DN 600, allows an angular deflection of up to 2 degrees.

This was the only way to pull the entire pipe string into the tunnel. Just how carefully and accurately TPS worked here is revealed by the fact that the pipe string, drawn over 500 m through curves and dips, emerged at the end of the tunnel with a deviation of only 10 mm from the theoretically calculated position. Had there been a technical glitch, which is always possible with such projects, the pipeline would have been lost as the microtunnel is



Pulling-in of two cast iron pipes simultaneously using specially developed mobile double pipe clamps.



Arrival at the target shaft. The extremely tight space conditions in the microtunnel are clear to see.

no longer passable after the pulling-in process. There is not only a small space left for the passage of a monitoring camera.

All requirements met

The client set high demands for the corrosion protection of the pipes. Therefore the cast iron sewer pipe with fibre-reinforced

cement mortar coating from Duktus (Wetzlar) GmbH & Co. KG was used. It guarantees not only perfect corrosion protection but it can also absorb condensation water without any problem.

The DN 400 pipes were installed with the help of pre-assembled pipe clamps in a microtunnel with an internal diameter of 1.6 m from the town of Zug, which mainly serves as a rainwater channel. This is blocked in places so that a few cast iron pipes lie completely in rainwater. In the Anergy network the medium is mixed with a 7 % ethanol blend, an antifreeze agent. Tests have shown that the internal coating of the DN 600 ductile iron pipes to EN 598 [1] consisting of high-alumina cement mortar and this ethanol mix are absolutely compatible.

With the absorption and release of energy, temperature fluctuations can occur in the medium with differences of up to 20 Kelvin. This has effects on the linear expansion of the pipes.

Cast iron pipes have a comparatively low expansion coefficient; also the BLS® push-in joint, with its play of around 4 mm in the longitudinal direction (without effect on the sealing action and thrust resistance), can also act as a compensator.

Everything done right

The “Circulago” project proves that 6 m long ductile iron pipes from Duktus/Hagenbucher are also extremely suitable for applications such as those required for the construction of Anergy networks.

The construction time for this major project in Zug was extremely tight; it was therefore important that good progress was made with the assembly of the pipes. Here again, the installation-friendly, pressure-resistant and, where necessary, easy to dismantle BLS® push-in joint proved its excellent suitability.

The Hagenbucher company is proud of the fact that it was commissioned by WWZ AG with the supply and installation of the ductile iron pipes for this project, which so far is unique in Europe and thanks all involved for the confidence placed in it.



DN 600 ductile iron pipes to EN 598 [1] with cement mortar coating from Hagenbucher/Duktus.



On pre-assembled rails the pipe clamps pulled from the other side roll slowly through the tunnel.



Pipe assembly DN 400 with protective epoxy finishing layer at Industriestraße

Keywords

Circulago, heating and cooling supply, energy generation, Lake Zug, DN 600 ductile iron pipes, DN 400 ductile iron pipes

Bibliography

[1] EN 598:2009-10



The very narrow space conditions on the installation side of the tunnel.
Pictured here: the placing of a pipe on the transport clamp.

Material build in from Hagenbucher:

Pipe pulling-in, lake water power station – Aabach – Gubelstraße:

- Total approx. 1,900 m pipes:
- 318 x 6 m DN 600 ductile iron pipes with cement mortar coating from Hagenbucher/Duktus
 - 163 double pipe clamps
 - 670 special bolts for the rails

Pipe assembly, Industriestraße:

- Total approx. 1,800 m pipes:
- 300 x 6 m DN 400 ductile iron pipes with protective epoxy finishing layer from Hagenbucher/Duktus

Author

Marco Nussbaumer

TMH Hagenbucher AG
Friesstraße 19
CH-8050 Zürich
Phone: +41(0)44 3064755
m.nussbaumer@hagenbucher.ch
www.hagenbucher.ch

Client:
WWZ AG

Rüdiger Werner

The technical service life of gaskets

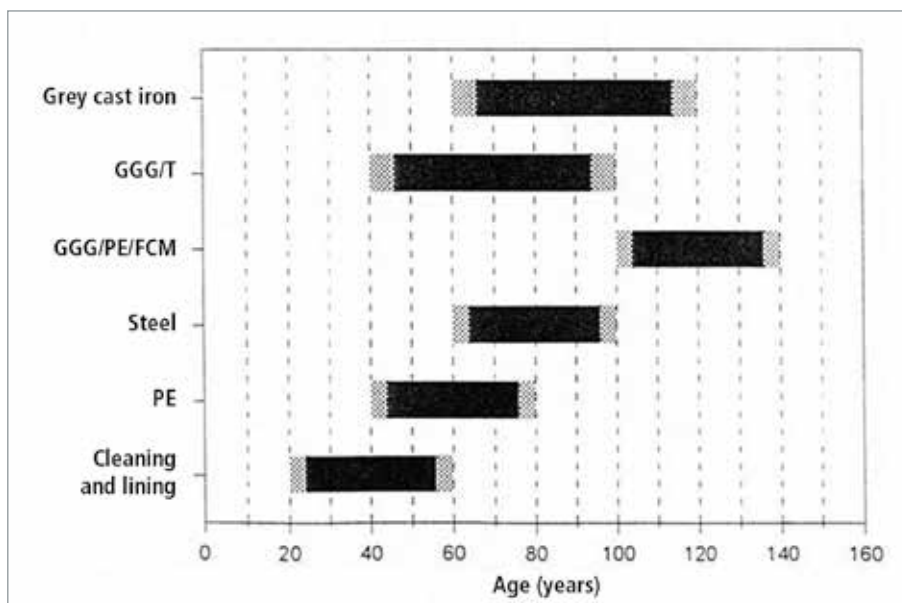
Long-term behaviour of elastomer sealing materials for water supply

Introduction

Elastomer seals in drinking water applications have already been examined in Volume 51 (2017) from the point of view of the increasingly strict and therefore more complex requirements for sealing materials in contact with drinking water. In the context of the requirements of the drinking water directive and the associated national and European hygiene requirements for organic materials in contact with drinking water, in the following article we shall look more closely into the long-term behaviour of elastomer sealing materials.

According to standards EN 805 [1] and EN 806-2 [2], pipes and pipe joints for drinking water supply and installation are to be planned for a working life of at least 50 years assuming correct maintenance and appropriate operating conditions. Based on the working life of the pipe system and/or the pipe materials, the joint system must function for at least as long as the pipes themselves. As a rule the technical working life of the pipe joints, i.e. also including that of the gaskets, is not taken into account in this consideration.

The gasket of the push-in joints in a cast iron pipeline is the heart of the piping system and achieve a working life of over 100 years, corresponding to the useful life of today's ductile iron pipelines, so that no water losses occur. This requirement is met among other things by observing the corresponding physical properties of the material. In addition the gasket must also meet all requirements and approvals as regards drinking water hygiene.



Technical working life according to pipeline groups – DVGW guideline W 401 (issue 1997).

Requirements for elastomer for use in drinking water applications

Independently of the hygiene and certification aspects of an individual country, the basic requirements for a seal are covered in EN 681-1 [3] (or ISO 4633) which addresses the physical properties of the materials.

Requirements for finished seals are defined in the relevant product and trade association standards as well as in client specifications. The performance of a pipeline seal or gasket is dependent on the material properties of the seal, its geometric form and the construction of the pipe joint.

The material of a seal, its recipe as well as the seal itself are subject to the requirements of standards and specifications. As a rule they are certified and have all the necessary documentation and type examination certificates. However,

the assessment of their behaviour over the long term is only marginal or even non-existent.

Performance of long-term tests and measurement of the compression set (CS)

An essential criterion for a reliable statement on the durable tightness of a pipe joint is the compression set (CS). The compression set provides information about the viscoelastic properties of a sealing material. The compression set is measured according to the ISO 815-1 [4] or ISO 815-2 [5] test method as follows:

- preparation of cylindrical test pieces and measurement of the initial height H_0
- deformation to H_1 (25% of H_0) for a determined time and temperature
- measurement of the thickness H_2 after load removal
- calculation of the compression set according to equation 1

In the context of predicting the long-term behaviour of seals, Woco has developed a validated calculation method and a test method in the context of a research project with the DVGW.

Using this method, it is possible to make a statement on working life in years. The basis of the test is the determination of the compression set of seals over one year with the variables of temperature and time. The results here are determined by means of the scientifically substantiated Arrhenius calculation process. According to this, the working life of a component is calculated by linear damage accumulation. This is based on time-temperature collectives which have actually been measured on pipelines or e.g. are known from geothermal measurements or are estimated as close as possible to reality.

This process has in fact been incorporated in DVGW test specification G 5406 [6] since 2016 and has been included in the draft standard prEN 549 [7]. Further investigations show that the method is also suitable for elastomer seals in water applications and hence can also be used for TYTON® gasket in order to carry out comparative measurements on competitive parts or to make calculated calculations about long-term behaviour.

In the context of internal market studies we have already assessed numerous gaskets in the widest range of materials according to this process, which serves as a basis for further developments and innovations.

Following there are concrete results and the working life of a TYTON® gasket/Woco seals-EPDM from Pipe System Components:

As mentioned above, the time-temperature collective is an essential basis for considering working life. An underground drinking water supply pipeline is allocated for the calculation of a temperature profile for one year. Depending on the region, this pipeline is seldom or never at minus degrees and indeed is also seldom operated at temperatures > 20°C. This is confirmed by investigations and discussions with experts in near-surface geothermal energy. Drinking water supply

pipelines typically lie at a depth of around 1.20 to 2 m, i.e. in the so-called near-surface area.

The near-surface earth temperature is determined by three factors:

- the specific climate on the earth's surface
- the composition of the soil (thermal conductivity) and
- the depth



DVGW type examination certificate for Woco IPS GmbH.

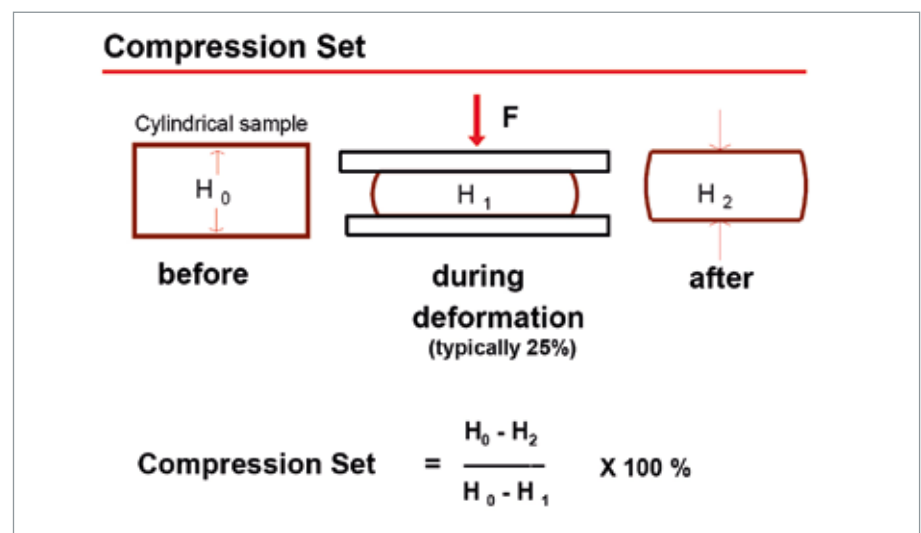
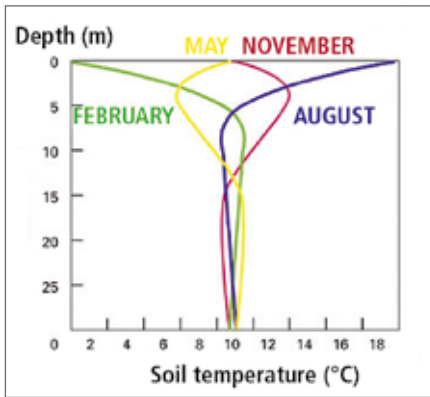
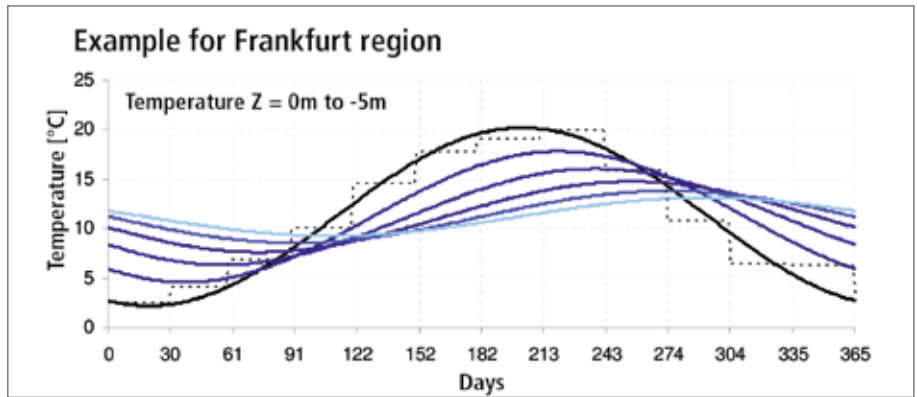


Illustration of compression set measurement to ISO 815-1 [4] or ISO 815-2 [5] and equation 1.



Temperature progression underground [8].



Transient soil temperature through the year [9]. The 2nd curve from the top (at the beginning of the diagram) is the temperature measurement at a depth of 4 m. This allows the time-temperature collective to be deduced over one year.

As the temperature collective used for the calculation, the distribution across one year shown in the table has been selected. It reflects the near-real circumstances and is also a rather critical assumption of the distribution.

Climate area →	Germany/summer
Temperature °C	time [hours]
-5	0
5	1.000
15	4.761
25	3.000
Summen →	8.761

Extract from the calculation software according to DVGW specification.

The compression set of the TYTON® gasket has been measured at three different temperatures of 60 °C, 80 °C and 100 °C, so that for each individual temperature a number of measurement values between a 20% and 70% compression set have been determined. The lowest temperature over a period of one year.

Then the working life is able to be calculated using the Arrhenius process described earlier. This has been based on a limit compression set of only 55%. As a rule, one calculates with about 70% or indeed even higher limit values, which would then increase the working life positively again. Hands, a more critical value also selected for the calculation. The limit compression set gives the value of elastic deformation or recovery which still remains after the calculated working life! Thus, after "x" years, a seal still has a small compression set, this reflects a high quality level for the seal and hence of the material as regards recovery.

Result:

In the operating temperature range selected, the TYTON® gasket in the Woco-Seals/EPDM material has an expected working life of 164 years with a limit compression set of 55%.

Conclusion

With regular production according to the standards, professional installation and normal operation, the excellent material quality of the TYTON® gasket from PSC/Woco ensures a useful life for the entire pipeline system for the next 100 years.

Our elastomer materials have been used in drinking water applications for over 50 years and have proved themselves extremely well in practice. Long-term testing and compression set tests substantiate the practical findings very well. Despite new directives and guidelines – regarding hygiene safety and microbiological growth tendencies – we are and will remain in a position to offer high-performance materials for a wide range of applications in the water supply industry.

Woco IPS – Pipe System Components supplies the user with the various materials in hardness grades of 55-85 Shore A for pipeline seals and sealing systems.

- Yellow highlighted: Input of values
- Light blue highlighted: Requirements according to FprEN 549
- Red highlighted: Pay attention / action necessary
- Green highlighted: Output

Block 1

1.1 Input of CS lab results into the worksheets "Messwerte T1", "Messwerte T2" and "Messwerte T3" and display the graph CS vs. time for these 3 temperatures.

- T1 Erfolgt!
- T2 Erfolgt!
- T3 Erfolgt!

1.2 Definition of the CS limit value.

CS limit value [%]: 55 <--max.70 % permitted!

Definition of the CS limit value.

CS limit value [%]: 55 <--max.70 % permitted!

1.3 Output of calculated times and R_1^2 .

	Time / CS limit value	$R_1^2 =$
T1	6.311	0.993
T2	670	0.988
T3	90	0.991

1.4 Verification of R_1^2 , compare the 1.3-values with R_1^2 required.

R_1^2 required = 0.980

- if R_1^2 (T1 or T2 or T3) < R_1^2 requirement, then check CS graphs for "outliers", where necessary repeat tests
- if R_1^2 (T1 or T2 or T3) > R_1^2 requirement, then input of temperatures

- Temperatur-Eingabe T1: 60
- Temperatur-Eingabe T2: 80
- Temperatur-Eingabe T3: 100

continue with Block 2

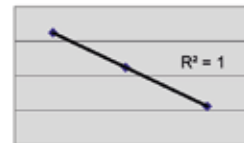
Block 2

2.1 Take over Block 1 values for Arrhenius calculation. (automatic, provided Temperatur-Eingabe T1 - T3 is complete)

2.2 Verification Arrhenius- $R^2 > R_2^2$ required.

Arrhenius- $R^2 = 1,000$ R_2^2 required = 0.980

- if Arrhenius- $R^2 < R_2^2$ required, then check Block 1 for plausibility
- if Arrhenius- $R^2 > R_2^2$ required, then continue with Block 3



Block 3

3.1 Take over Block 2 values for final calculation.

3.2 Output for time temperature collective, used profile is

Life time [Years]: 164
at a CS limit value of [%]: 55

Tyton 51M5567 / Germany

Extract from the calculation software according to DVGW specification.

Keywords

Elastomer sealing materials, compression set (CS), long-term behaviour, calculation process, test method, TYTON® gasket

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Author

Rüdiger Werner

Woco IPS GmbH
Pipe System Components
Hanauer Landstraße 16
D-63628 Bad Soden-Salmünster
Phone: +49(0)6056 78-7229
ruwerner@de.wocogroup.com
wocogroup.com

Roger Saner

The new Galgenbuck tunnel in the region of Schaffhausen

Traffic safety thanks to ductile cast iron extinguishing water pipelines

Schaffhausen with its Munot fortress

The town of Schaffhausen is the most northerly-lying town in Switzerland and, with more than 35,000 residents, forms the centre of the similarly named Canton of Schaffhausen. It is one of the small Swiss towns to the North of the High Rhine at the border between Germany and Switzerland and to the South-East of the Randen in the Table Jura.

The landmark of Schaffhausen is the Munot. This mediaeval fortress with its pronounced circular shape was part of the town's fortification and was built between 1564 and 1589, partially involving slave labour by the burghers of Schaffhausen.

Another tourist attraction of Schaffhausen is the Rhine Falls, located 2.5 km downstream in the district of Neuhausen am Rheinfall and Laufen-Uhwiesen. With a height of 23 m and a width of 150 m, it is one of the three largest waterfalls in Europe. At an average flowrate of the Rhine, approximately 370 m³ of water tumbles

over the rocks every second and in Summer this can be up to around 600 m³ per second.

Congestion relief for the region of Schaffhausen

The A4 Autobahn connects Schaffhausen with the German A81 Autobahn A81 in the North and with the city of Winterthur in the South. After the opening of the A4 bypass in August 1996 there was an enormous change in the traffic flow in the Schaffhausen and Neuhausen region. This subsequently led to a huge increase in the traffic load on the feeder roads to the Schaffhausen South junction, in turn causing congestion in the region around Neuhausen am Rheinfall to increase massively. Meanwhile, more than 25,000 vehicles a day were travelling along this section of road.

In 2007, the Council of the Canton of Schaffhausen presented the implementation project for the new two-lane Galgenbuck tunnel which, as a bypass route, should almost halve the traffic load in the district of Neuhausen am

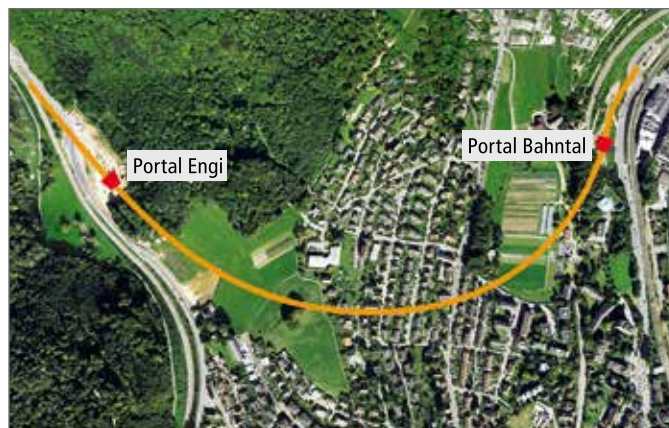
Rheinfall and make the Schaffhausen South junction viable in the long term. As an additional secondary effect, Neuhausen am Rheinfall would benefit from a reduction in the burden of noise and air pollution, from shorter journey times and a minimisation of accidents. The cost of constructing the new tunnel, of approximately 240 million Swiss francs, is covered in full by the Federal Government (the Swiss Confederation) as, legally speaking, this is the restructuring of a national road link.

The new Galgenbuck tunnel project

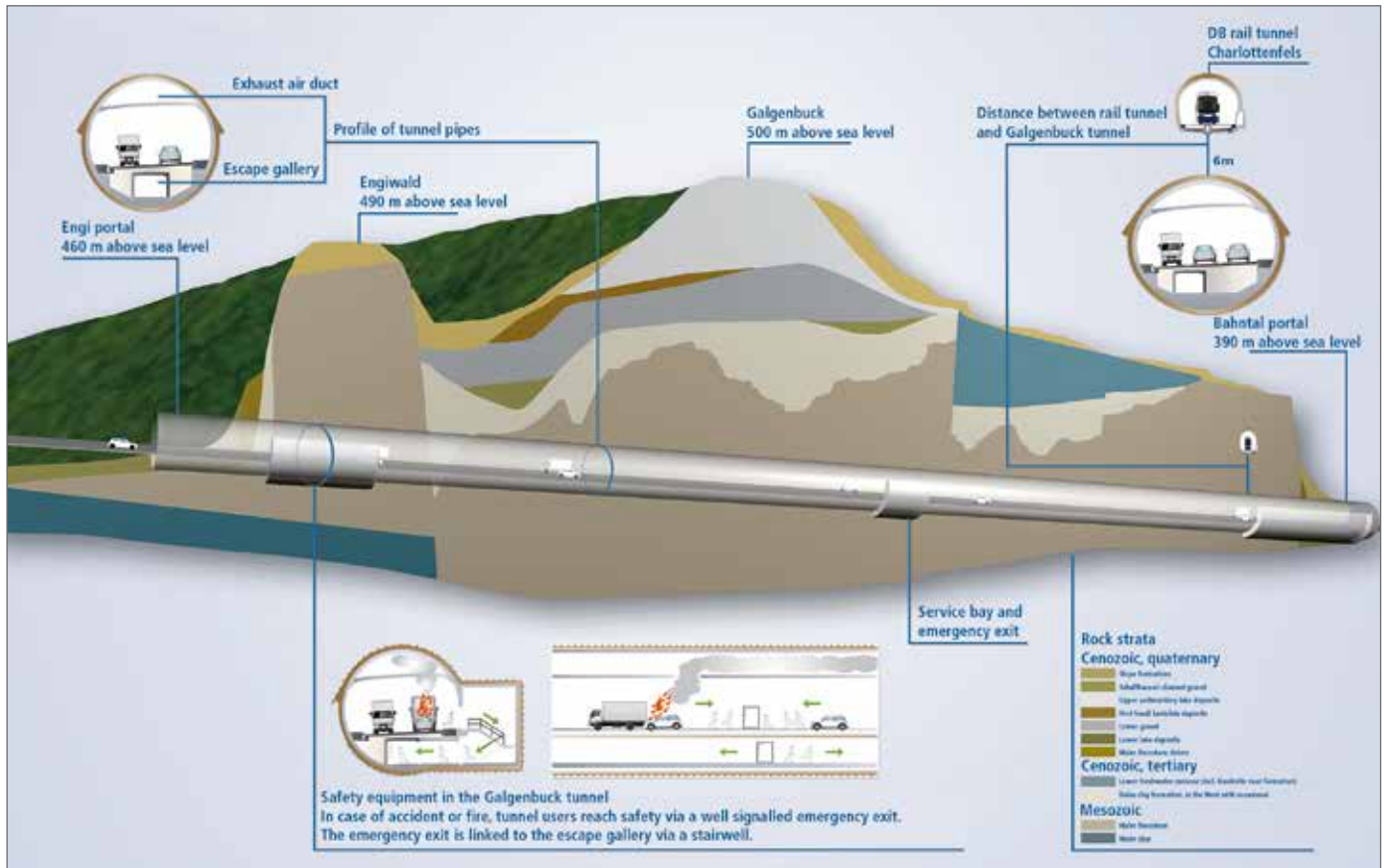
The new Galgenbuck tunnel passes under the municipality of Rheinfall in a wide arc with a rock cover of only 20 to a maximum of 70 m. The two-lane road in the tunnel runs for a total length of 1,138 m with a maximum gradient of 4.5 % from the "Engi" portal in the West to the "Bahntal" portal in the East close to the Schaffhausen South motorway junction. Once construction has started in 2011, the first stage was to complete the two tunnel portals as cut-



Munot fortress in Schaffhausen.
Source: <http://www.weinlandnet.ch>



The route of the tunnel.
Source: Bundesamt für Straßen (ASTRA), Switzerland



Schematic cross-section of the Galgenbuck tunnel.
 Source: Bundesamt für Straßen (ASTRA), Switzerland

and-cover tunnel sections, with the remaining approx. 1,060 m long tunnel section being driven as from the middle of 2013 using mining blasting techniques. Break-through was achieved as early as February 2016. After a little more than two years construction time, the concrete work in the tunnel was able to be concluded in July 2018 and the technical engineering and safety specialists could set



Completed service bay in the middle of the tunnel. Source: Bundesamt für Straßen (ASTRA), Switzerland

about their own tasks. The commissioning of the Galgenbuck tunnel is planned for 2019.

Installation of the extinguishing water pipeline in the service duct

With the installation of the operating and safety equipment which is currently underway, the empty concrete pipes are finally being turned into a tunnel. In the service duct located beneath the carriageway, the extinguishing water pipeline with its lateral outlets to the hydrant recesses at road level is the first thing to be installed. Following that will be the installations for monitoring and controlling the tunnel. In addition, the escape gallery is incorporated into the service duct.

The pressurised water pipeline in the service duct consists of ductile iron pipes of the vonRoll ECOPUR type in nominal size DN 250. It

runs for a total length of 1,060 m in alignment with the tunnel with a minimum curve radius of 500 m and is fixed to the concrete back wall and the floor of the service duct by pipe clamps. The changes of direction in the curve are accommodated by the deflectability of the push-in joints.

From the main pipeline in the service duct, lateral branch pipelines spaced a maximum distance of 150 m apart supply the seven hydrants in the road space with extinguishing water.

The branch pipelines are also constructed of ECOPUR full-protection DN 125 pipes in ductile cast iron and they run through a casing pipe above a chamber lying approximately 3 m below the hard shoulder to the hydrant connections. Dismantling the branch pipelines from the service duct is therefore possible at all times. For the installation, overhaul and



Extinguishing water pipeline along the service duct.



Branch pipeline from the service duct into the hydrant chamber.



A view from the road area into the hydrant chamber.



A bend in the pipeline route secured with a restrained joint Fig. 2806.



Hydrant recess with HYPLUS hydrant top part installed.

maintenance of the fire hydrants, the hydrant chamber is accessible at any time via an 80 x 80 cm large entrance from the road space.

The full-protection vonRoll ECO-PUR pipes are integrally coated with polyurethane (PUR) and are classified in accordance with standard EN 545 [1] as cast iron pipes with reinforced coating for use in all ambient conditions. Because of their highly resistant, pore-free PUR coating to EN 15189 [2] they can be used in all types of soils and therefore have the best protection against corrosion even in the aggressive climate of the tunnel. ECOPUR pipes have a polyurethane (PUR) lining in accordance with EN 15655 [3]. The mirror-smooth PUR lining minimises deposits and, because of extremely low friction losses (roughness $k = 0.0014$ mm accord-



Assembly of a hydrant base VARIO 2.0 on the riser in the hydrant chamber.

ing to SVGW W4 [4]), promotes the hydraulic performance of the extinguishing water pipeline in case of fire. In order to safely absorb the

forces occurring due to internal pressure, the entire pressurised water pipeline including the hydrant branch pipelines is secured against longitudinal forces by the assembly-friendly vonRoll HYDRO-TIGHT thrust protection system. The flexible cast iron pipe system is completed by vonRoll ECOFIT full-protection fittings with push-in and flanged joints which are also integrally protected with a thick epoxy coating to EN 14901 [5] and the enhanced requirements according to RAL-GZ 662 [6].

High-performance hydrants for extinguishing water supply

In order to fulfil the high requirements for fire protection, the hydrant recesses are equipped with the high-performance double-



Connection of the extinguishing water pipeline in the "Engi" portal with pipeline valve, cleaning facility and vent valve.



Pipeline shut-off valve, drainage and cleaning connections and lateral outlet to branch pipelines for hydrants.

armed vonRoll HYPLUS type hydrants which can deliver a maximum output of 4,000 l per minute (at a differential pressure of 1 bar). The patented joints between the top and bottom parts of the hydrants allow stepless 360° directing of the hydrants in the narrow installation recesses in the road space of the new tunnel.

The flexible VARIO 2.0 type H2L hydrant bottom with a maximum adjustment range of 70 cm (in 5 cm increments) offers optimal flexibility in the hydrant chambers when bridging over the existing level differences. The DUO maintenance shut-off installed as standard allows later overhaul work on the hydrant under full system pressure without decommissioning the extinguishing water supply.

Full-protection valves for secure operation and simple maintenance

At the high point of the tunnel – at the extinguishing water pipeline connection in the Engi portal – vonRoll VS 5000 type shut-off valves are used as pipeline valves and for cleaning purposes. At the same time a vonRoll vent valve is arranged at this point to extract air from the extinguishing water pipeline. The extinguishing water pipeline in the service duct equipped with a VS 5000 pipeline valve at each hydrant branch pipeline and it is divided into

individual sections so that, in case of maintenance work, the entire pipeline does not have to be taken out of operation. There are also cleaning and drainage connected connections installed at the same point for servicing and cleaning work.

Conclusion

The safety and security infrastructure in motorway tunnels takes first place with the tunnel operators, not least because of the devastating and catastrophic fires which have occurred in certain tunnel structures in the past.

Ductile iron pipe systems have proved their worth for extinguishing water pipelines in road tunnels for decades now and in case of fire events they are extremely reliable for delivering firefighting water. The flexibility of the sockets of ductile iron pipe systems make very flexible and efficient installation of the extinguishing water pipelines possible in the tight conditions inside the tunnel. Because of its mirror-smooth surface, the innovative lining with polyurethane avoids friction losses in the system, which in turn results in an increase in hydraulic performance when the water is drawn off. Ductile iron pipes ensure a high degree of operational security of the extinguishing water supply in challenging tunnel structures.

Keywords

Extinguishing water pipelines, Galgenbuck tunnel, service duct, full-protection pipes, pressurised water pipeline, branch pipelines, full-protection valves, hydrant top part, hydrant bottom part

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- [6] RAL-GZ 662: 2008

Author

Roger Saner

vonRoll hydro (suisse) ag
 von Roll-Strasse 24
 CH-4702 Oensingen
 Phone: +41(0)62 3881237
 roger.saner@vonroll-hydro.ch
 www.vonroll-hydro.ch

Reduce the costs of pumping and the risk of damages

The ventilation of pressure pipelines

Background

Air trapped in completely filled pipelines is basically undesirable. Even if air does not get into the pipeline during filling, small gas bubbles (air, carbon dioxide etc.) are also formed during operation. Little by little, these can then merge to form larger bubbles and rise to the top. As a result, they then collect at high points in pipelines and form air cushions there. The consequences can vary considerably:

- The interpretation of tightness tests before the commissioning of pipelines is made more difficult.
- The reduction of the free cross-section available for flow and the higher pressure losses in the pipeline associated with this can mean that the output of pumps is restricted; pumping costs increase.
- It can cause vibrations in pumps and valves.
- Pressure surges are intensified and this can cause damage to pipelines.

For drinking water pipelines there are descriptions e.g. in DVGW data sheet W 334 [1] of how accumulations of air can cause considerable dynamic pressure changes as a result of the different densities of the two media. Therefore pipelines must be air-free and must be kept air-free. Air can get into pipelines in different ways, for example:

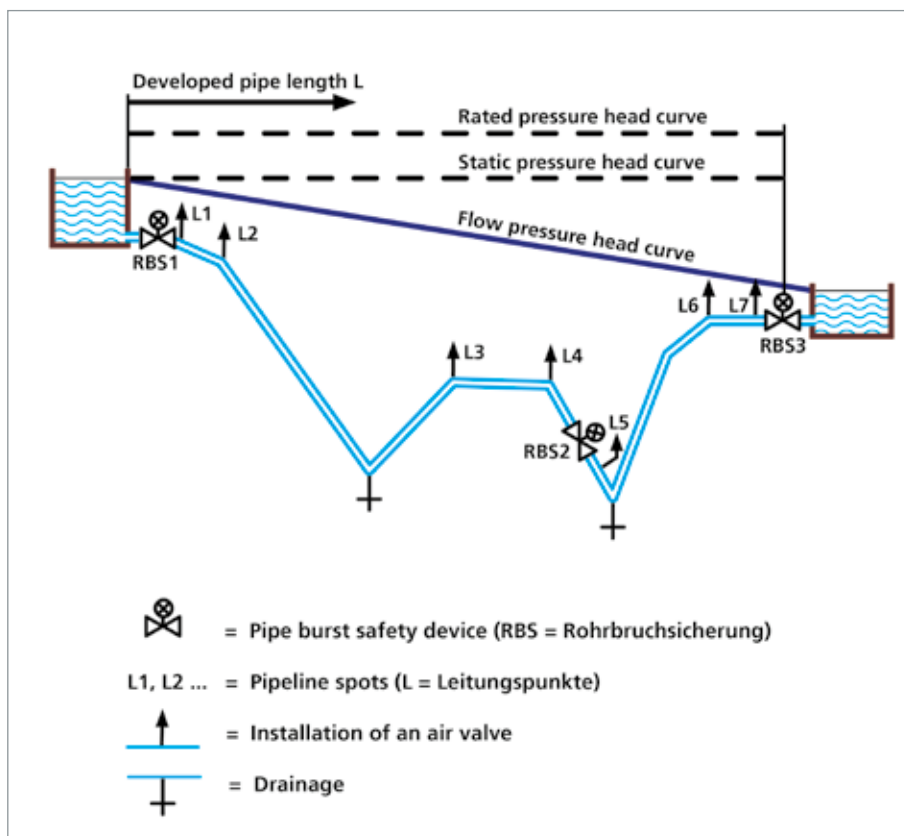
- dissolved in water
- already present in empty or drained pipelines
- sucked in at high points
- sucked into the sump of pumps
- drawn in via an air vessel

The commissioning of a pipeline represents a special case. Directly after construction, the whole system is filled with air and must first be filled up with a liquid. Attention must be paid to the following here: if, when filling pipelines, air is expelled via vent valves, the filling speed must be kept as low as possible. The dreaded pressure surge (Joukowsky surge), which occurs if the float of the vent valve closes the valve seat abruptly at the end of the filling process, must remain below the admissible pressure load (PMA = maximum pressure occurring temporarily, including pressure surges, which a part of a pipeline in operation can withstand [2]) of the pipeline. As a rule, the admissible pressure surge is limited to 3 bars for safety

reasons. The filling speed is limited to 0.25 m/s in accordance with DVGW data sheet W 334 [1].

In order to secure the pipeline against inadmissible pressure fluctuations for problem-free operation then, depending on the operating state, ventilation or air release is necessary for the pipeline components. The gas bubbles (air, carbon dioxide etc.) trapped in pipelines reduce the free cross-section available for flow, increase the pressure loss in the pipeline and in some cases cause undesirable pressure surges.

The size and number of vent valves is to be determined according to the nominal width size of the pipeline, the filling volume, the topography and the maximum



Installation locations for aeration and air release valves in a pipeline.

permissible air speed in the narrowest cross-section of the vent valve (main venting).

As regards the level of ventilation, as a rule it is assumed that the pressure should not fall below the absolute pressure of 0.8 bar (0.2 bar negative pressure) in the pipeline. According to experience, the limit is respected with sufficient certainty if the air entry speed in a correctly dimensioned vent valve is not above 80 m/s this speed of 80 m/s should also not be exceeded for reasons of noise pollution.

Ventilation and air release valves are generally installed in shafts or buildings. They can also be arranged on pipelines which run above ground. However, there are also designs of ventilation and aeration fittings which are suitable for installation underground.

Ventilation and air release

Ventilation by automatic vent valves is necessary in the following cases:

- draining sections of the pipeline
- in case of underpressure occurring, to protect the pipeline (for example behind pipe break protection devices)

Air release is not necessary in normal network operation as air release automatically occurs through branches, hydrantes and above all house connections. Even with long-distance pipelines, no forced air release is necessary if the speed of flow is sufficient, even when the pipeline is on a downward gradient, to carry the air bubbles with it. In cases where disruptive accumulations of air can form, automatically acting air release valves are to be provided. Air in water pipelines is mainly to be expected in places where certain conditions arise such as pressure reductions and temperature increases.



Example of aeration and air release valves.

So air bubbles form at

- geodetic high points (L 1, L 3, L 6, L 7) and
- hydraulic high points (L 2, L 4).

Hydraulic high points can possibly form in certain operating situations and are temporary in nature.

Air release by automatically acting air release valves is necessary in the following cases:

- draining sections of the pipeline
- in case of underpressure occurring, to protect the pipeline (for example behind pipe break protection devices)

Choice of different aeration and air release devices

Most designs of aeration and air release devices are based on the float principle, with and without lever reinforcement.

Float principle

Ventilation and air release valves using the float principle are designed with a main vent section with a large aeration and air release cross-section and an operational vent section with a smaller aeration and air release cross-section. The main aeration and air release is there to remove or drive large volumes of air from the pipeline. This is the case if pipelines are being filled or emptied.

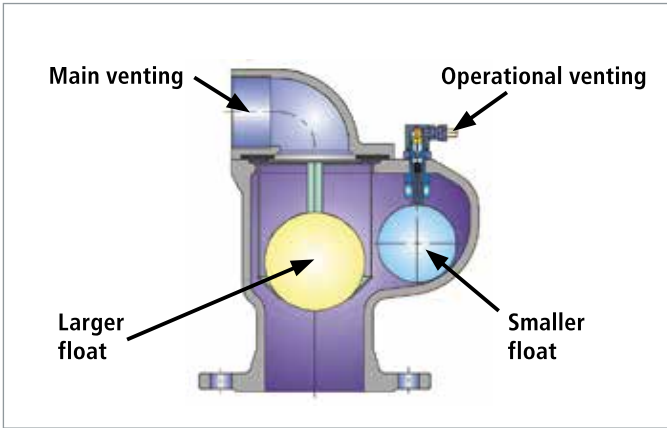
As soon as the operating medium reaches the large float of the main vent section during filling, it is raised and always remains closed under pressure. Smaller volumes of air which can occur during normal operation are taken away via the operational vent section. The smaller float is then raised by the operating medium and closes the nozzle of the operational vent section. It always opens if air bubbles collect in the housing during operation.

Valve lever function

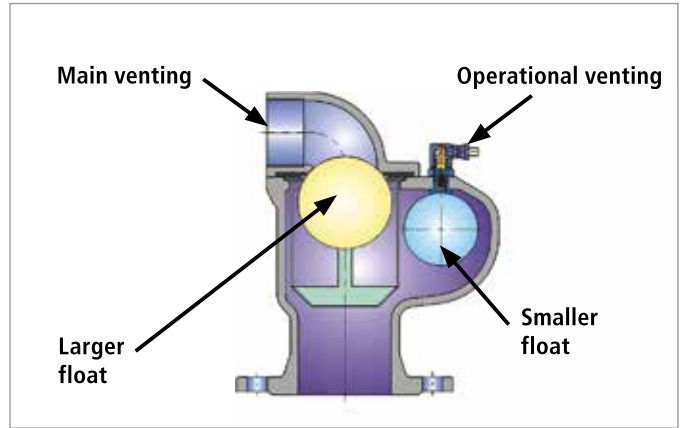
With aeration and air release valves with a lever function, valves are opened and closed by a lever in the components; depending on the application, different construction forms are used.

Particular construction forms

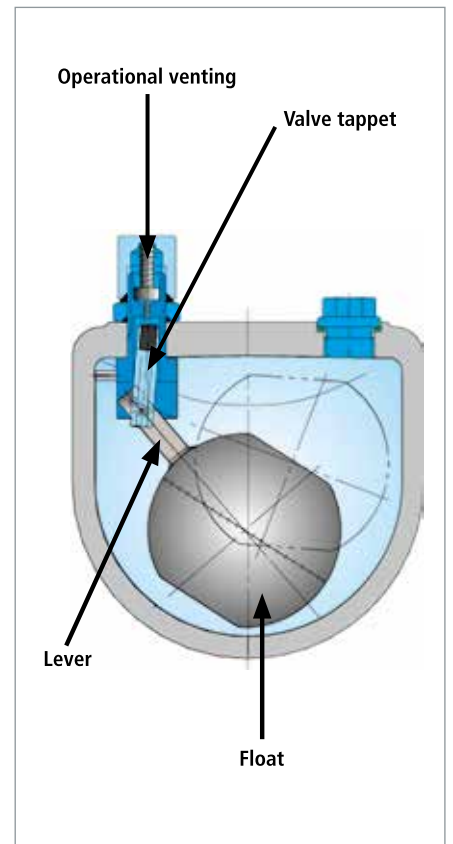
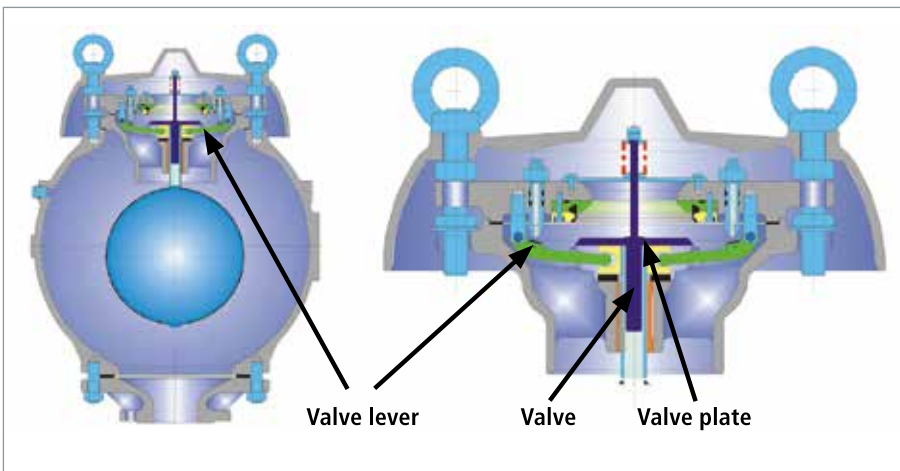
In addition to the construction forms described above, particular types of design have been developed for operational reasons. Dynamic pressure brakes are used in order to protect aeration and air release valves from pressure surges. There is a shut-off body mounted in the valve housing which can be moved by the flow. When a certain flow speed is exceeded the medium pushes the shut-off body into the valve seating. Only a reduced cross-section remains free.



Position of the float when filling or draining a pipeline: aeration and air release valve with large and small floats opened.



Position of the float in the operating state without air in the system: the valves of the main aeration and air release and operational aeration and air release are tightly closed since there is no air accumulation in the pipeline.



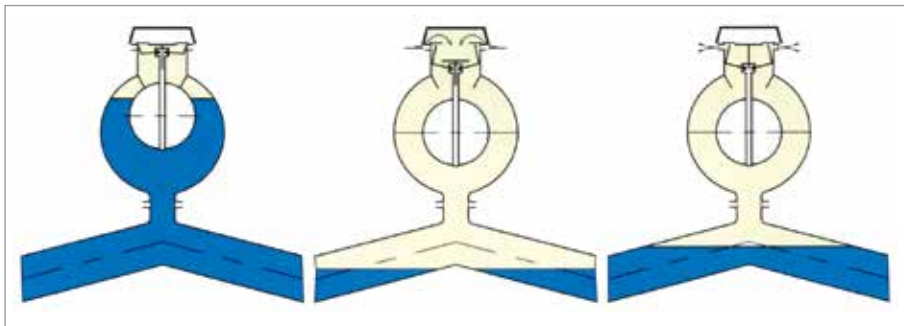
Different construction forms of aeration and air release valves with lever function. Top left: sectional view of a single-chamber valve with valve lever for small and large volumes of air; bottom left: aeration and air release valve with lever function for wastewater pressure pipelines; right: The illustration shows operational air release. The float is attached to a lever. A valve tappet on the lever closes the air release port under positive pressure. With negative pressure, the float drops and the port is opened. Air can escape.

So that the aeration and air release valve can be isolated from the pipeline for overhaul purposes, a gate valve is often installed before the aeration and air release valve. This means that the aeration and air release valve can be dismantled or cleaned while the main pipeline is still

operational. A soft-seated valve is best suited to this function as it allows a free passage. In order to prevent aeration with small aeration and air release valves and only ensure an air release function, aeration and air release valves with suppressed air inflow are often used. These valves have

their main application in suction pipelines for mechanically purified water or in the area drinking water.

If air is emitted during the filling of pipelines via vent valves, the filling speed must be kept as low as possible. The dreaded pressure surge (Joukowsky surge), which occurs



The mechanism of floats and valve lever function.

Left: The valve is closed. The float is in its up position.

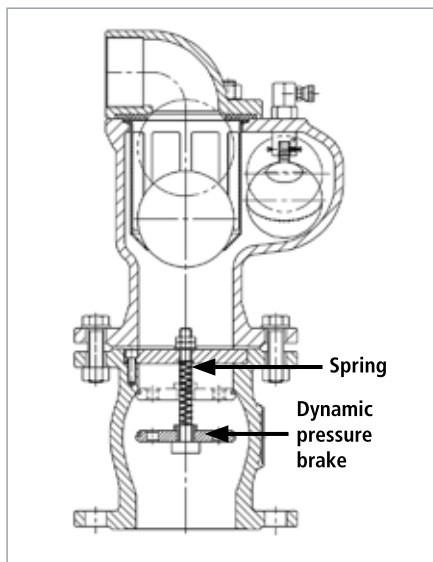
Centre: Under negative pressure the float drops. The nozzle valves open and air is admitted into the pipeline. The liquid level drops accordingly.

Right: As soon as the pressure wave changes to a positive pressure, the middle valve disk closed the large nozzle. Here the free-moving valve disk is acting as a check valve. The air contained can only escape slowly and in a controlled way via the two small nozzles. The two water columns are slowed down and slowly flow into together. Abrupt collision and the resulting consequences are avoided.

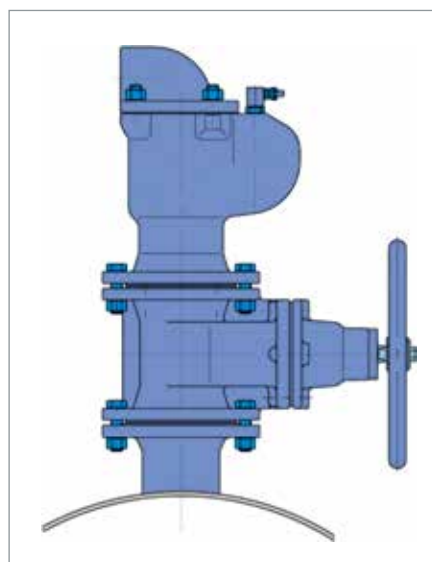
if the float of the vent valve closes the valve seat abruptly at the end of the filling process, must remain below the admissible pressure load (PMA = maximum pressure occurring temporarily, including pressure surges, which a part of a pipeline in operation can withstand [2]) of the pipeline. As a rule, the admissible pressure surge is limited to 3 bars for safety reasons. The filling speed is limited to 0.25 m/s in accordance with DVGW data sheet W 334 [1].

The size and number of vent valves is to be determined according to the nominal size of the pipeline, the filling volume, the topography and the maximum permissible air speed in the narrowest cross-section of the vent valve (main venting).

Basically, aeration and air release valves are installed in shafts. Their construction is described in DVGW worksheet W 358 [3]. In order to economise on the structure of the shaft, special ventilation and aeration fittings for installation underground are used. On the left on the next page an aeration and air release valve is illustrated which ventilates in the underground area via a surface box. Installation beneath surface boxes ensures accessibility. The illustration on the right shows an above-ground design.

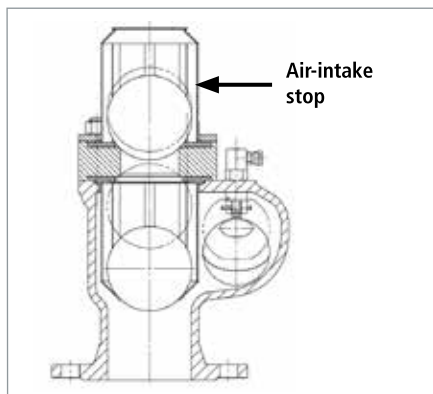


Aeration and air release valve with dynamic pressure brake.

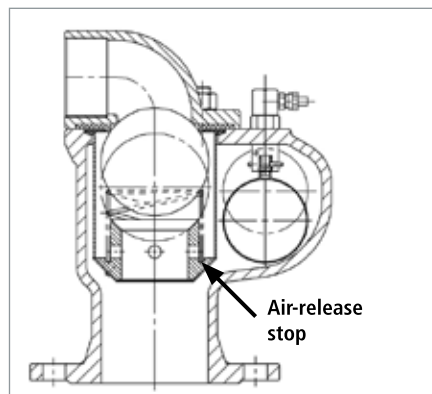


Aeration and air release valve with shut-off gate.

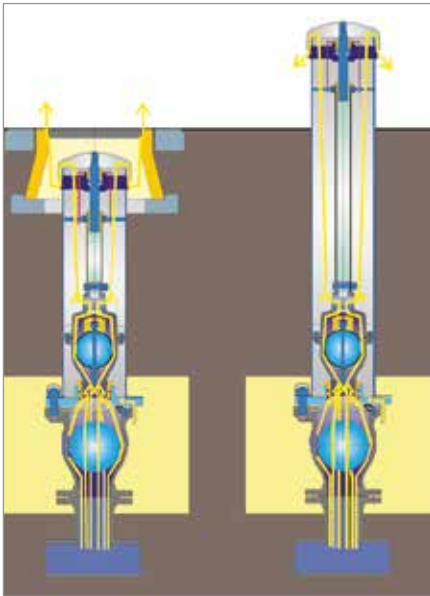
There are aeration and air release valves for supplying and discharging small volumes of air. In this case the valve has a female thread and can be mounted directly on the pipeline. Valves of this kind are predominantly used in building installations.



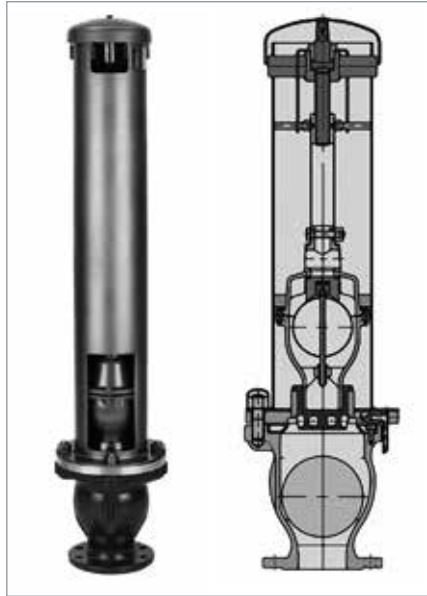
Aeration and air release valve with suppressed air inflow.



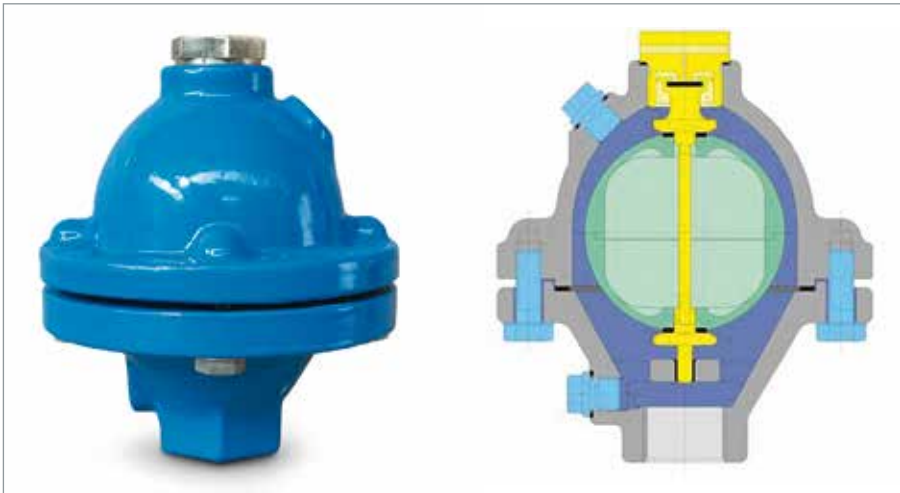
Aeration and air release valve with suppressed air outflow.



Aeration and air release fittings for installation beneath a street box.



Aeration and air release fittings, above-ground design.



Aeration and air release valve for small air volumes with female thread connection.

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- [2] EN 805: Water supply – Requirements for systems and components outside buildings [Wasserversorgung – Anforderungen an Wasserversorgungssysteme und deren Bauteile außerhalb von Gebäuden] 2000
- [3] DVGW-Arbeitsblatt W 358: Leitungsschächte und Auslaufbauwerke [DVGW worksheet W 358: Manholes and outlet structures for piping systems] 2005-09

Authors

Dr. Jürgen Rammelsberg

Christoph Bennerscheidt

EADIPS®/FGR®

European Association for Ductile Iron Pipe Systems/
Fachgemeinschaft Guss-Rohrsysteme e. V.

Doncaster-Platz 5

D-45699 Herten

Phone: +49(0)2366 9943905

c.bennerscheidt@eadips.org

j.rammelsberg@eadips.org

eadips.org

Wall thickness calculation for ductile iron pipes

Update in the EADIPS FGR manual

The Ductile Iron Pipe Systems manual provides planners, construction companies and network operators, as well as higher education and training institutions, with an overview of current expertise in the field of ductile cast iron pipes, valves and fittings. The individual chapters are regularly checked to make sure they are up to date and revised by the EADIPS FGR technical committee if necessary. In addition, the manual is supplemented by new, user-oriented chapters.

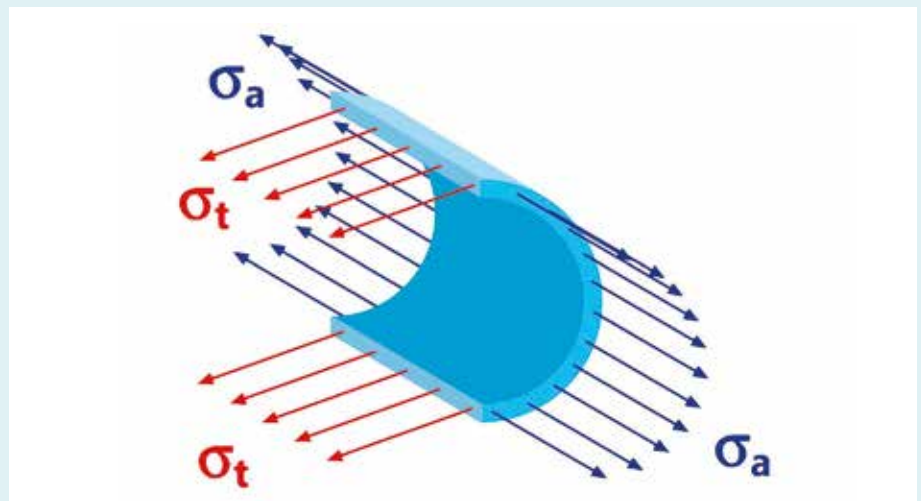
Wall thickness calculation for ductile iron pipes

Because of changes in the European regulations, the former Chapter 5 "Pipe design and wall thickness calculation" (edition 04/2008) has been revised and replaced by the updated Chapter 5 "Wall thickness calculation for ductile iron pipes" (edition 08/2018)

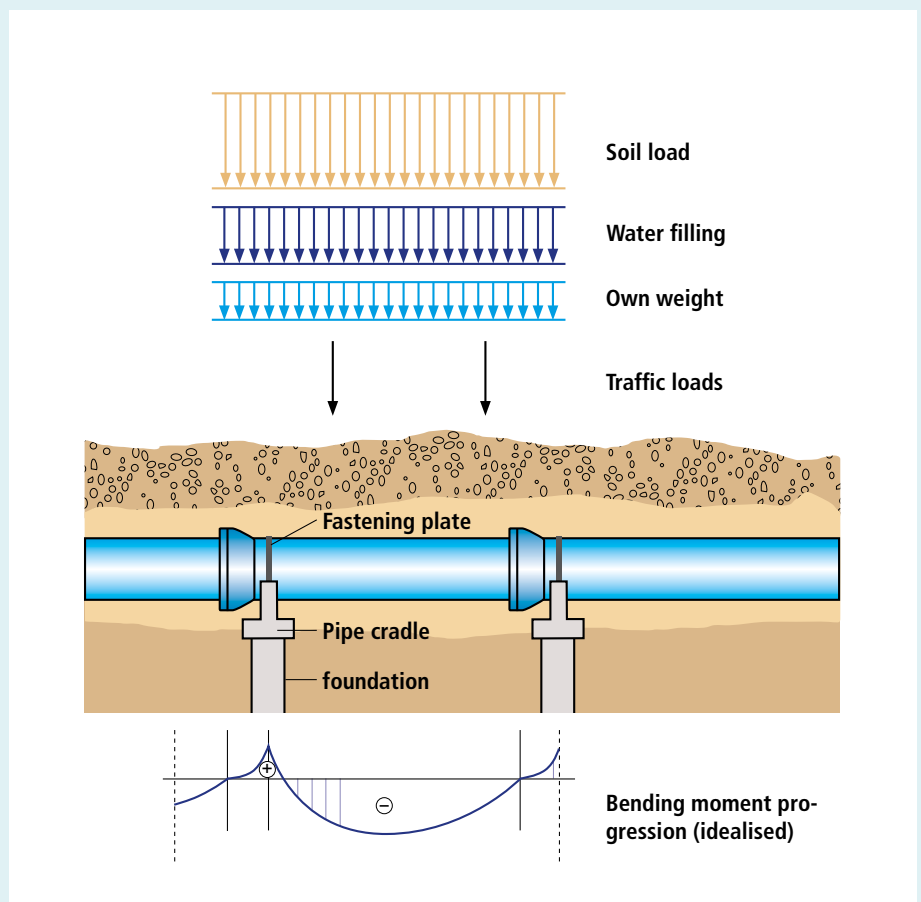
Chapter 5 now covers the following points:

- Explanation and illustration of the stresses in the pipe wall of push-in-joints and restrained socket joints
- Development of the minimum wall thicknesses of ductile iron pipes
- The effect of longitudinal bending strength and ring stiffness on the calculation of pipe wall thickness dimensions
- Comparison of wall thickness classes (K-classes) and pressure classes (C-classes) for non-restrained flexible pipes
- The effect of restrained socket joints on the wall thickness of ductile iron pipes

Chapter 5 has been published in both the German-language version Handbuch Guss-Rohrsysteme and the English-language version Ductile Iron Pipe Systems manual. Both versions can be downloaded as interactive ebook free of charge via the eadips.org homepage.



Stresses produced by internal pressure in a wall of pressure pipes assembled with restrained joints



Bending moments for a buried pipeline on piles

Patricia Pfister

Modernisation bit by bit

Robust cast iron pipes for the Feldkirchen drinking water network

Maintenance is rewarded

Regular servicing and maintenance of a drinking water network pays off. This is also one of the reasons why the urban area of Feldkirchen in the Federal State of Carinthia is particularly anxious to replace their ageing pipes or pipelines whose dimensions no longer correspond to current requirements. Therefore the municipality is responding to a recommendation by the Austrian audit office which advises communities that they should renew around 2 to 3 % of their network of drinking water pipelines each year. The great advantage here is that, in addition to a very well maintained water pipeline network, the funding authorities have also reacted to this recommendation: they are supporting those communities

which maintain their piping network on a regular basis with a higher subsidy. *“There are major differences here: about 10 to 15 percent difference in the subsidies for those communities who have carried out maintenance work regularly as compared with those who have not bothered to do this”,* explains Kurt Karnberger, engineer and area manager for water in Feldkirchen. *“A community which has done nothing for 50 years and whose entire network needs to be renovated at one go is looking at a sum in the millions. Remaining inactive for the entire period is penalised by a lower subsidy rate. And if this is 15 percent instead of 25 percent, naturally it makes a huge difference.”* Therefore this becomes a kind of reward system for “diligent” communities.

Ratio of resident number to supply area

The lasting financial advantage is only one aspect of the reason why the urban community checks the performance of their water supply network regularly; the topography of Feldkirchen is another one. The community counts barely 15,000 residents spread over an area of around 77 km², which equates to a considerable spread in relation to population numbers. As a comparison, the similarly named Feldkirch in Vorarlberg has twice as many residents but only half the area. Even the ten times larger city of Salzburg contents itself with the same area as the urban community of Feldkirchen.



The particular challenge for the renewal work was guaranteeing the water supply for the town and the surrounding area even during the construction work. Various different alternatives were considered for this, which also carefully scrutinised the scheduling of construction stages so as not to disrupt the traffic too much.

The low building density across a supply area which is nevertheless large poses a challenge for the network operator in terms of supplying every residence, even those located at the edge of the urban community, with sufficient drinking water. For this reason, on the one hand Feldkirchen has a large arsenal of supply sources available to it – with 17 pumping stations, ten wells and one deep well plus 15 elevated tanks with a volume of 3,500 m³, 4,000 domestic connections across a 230 km long network of pipelines are supplied – and on the other hand the piping network is being recalculated for the planning of a new housing project.

Calculation of pressures and volumes

SETEC Engineering GmbH & Co. KG was commissioned to carry out the hydraulic pipe network calculation for the Feldkirchen supply system. Taking all the data on the dimensioning and routing of the pipelines into account, the pressure

and volume characteristics of the network were considered. What volumes of water are required at peak times, whether these can be transported by the existing piping network or whether adaptations are necessary were the results of the calculation. For example, a need for adaptation in the form of an enlargement of the pipeline cross-section was identified in one area of the main supply pipeline in the network.

In order to guarantee the security of supply of drinking water and water for other purposes, both for the town and for the newly developed land around it, it was decided to extend the existing system. *“Wherever the dimensioning is calculated to be too small, we are keen to adapt the piping network to this calculation. Added to this are the constantly ongoing extensions for new-builds and new developments”*, says Kurt Karnberger. Furthermore, during the course of the work, the commissioning of new pumping stations for the hinterland of Feldkirchen is included

in the project. The total cost of this major project thus comes to around one million euros. It was completed at the end of 2017.

Uninterrupted water supply

The particular challenge for the renovation work completed to date was guaranteeing the water supply for the town and the surrounding area even during the construction work. Various different alternatives were considered for this, which also carefully scrutinised the scheduling of construction stages so as not to disrupt the traffic too much. As a result, the first construction stage to be completed was the one which ensured the supply of the urban community from the deep well. By means of this initial measure, the nucleus of the community of Feldkirchen was supplied with drinking water from the deep well for a week and those in the outlying settlements of the urban community of Feldkirchen were supplied from the small wells.



Installation of various valves and hydrants in the piping network.



5,750 m cast iron pipes from Tiroler Rohre GmbH have been installed in the last three years. They replace the ageing PVC pipes.



A few stream crossings had to be made in the course of the construction work. A problem here was the fast rise in water levels on site shortly after a period of bad weather with heavy rainfall.

Crossing the railway was the greatest challenge

Because of careful and extensive advance planning, particularly as regards when each stage of construction should be tackled, those responsible for the project expected the work to run smoothly. This was also due to the good cooperation between the planning office, CCE-Ziviltechniker GmbH, and the Feldkirchen urban community employees. The contractor, together with the urban community, decided to use ductile iron pipes from Tiroler Rohre GmbH in nominal sizes DN 100, DN 125, DN 150 and DN 200. There was one construction phase, where DN 200 pipes were installed, which proved a particularly tricky task for those in charge: *“The biggest challenge was crossing the railway line, where it was not clear whether it would work, as we could*

only use an abandoned rainwater drainage channel. This does not run straight but is slightly curved”, reports water engineer Werner Drolle. *“We had the standard design of five meter pipe lengths in stock. However, bending with smaller units was luckily not necessary.”*

The robust DN 200 ductile iron pipe can be bent deflected up to 4 degrees. Thanks to this flexibility of the joint, the pipes could follow the curved course of the rainwater channel. Feldkirchen saved money here as there was no need to use fittings and the work could progress more quickly. *“Otherwise it would have been more expensive. Because the alternative would have been to undertake the crossing of the double-track railway line in the urban area using the open-trench technique”,* explains the area manager for water.



On grounds of the long working life and the quality of the material, Feldkirchen decided in favour of ductile iron pipes from Tiroler Rohre GmbH in nominal sizes DN 100, DN 125, DN 150 and DN 200.

The crossing of the Tiebel, Feldkirchen's main river, was a particularly wet experience. In the rainy year of 2017, storms with heavy rainfall meant that, within a few hours, the entire construction site was under water. The extreme amounts of water were fought by diversions and pump-outs.

From PVC pipes to ductile iron pipes from TRM

In the nineteen sixties and seventies, a great deal of housing development occurred in the whole of Austria in the context of the economic miracle. In the course of this, in Feldkirchen too, a network of pipelines came into being, for the most part in PVC pipes. However, in the last two decades these PVC pipes have come to the end of their useful life and have gradually been replaced. In the meanwhile, in Feldkirchen, ductile iron pipes have been preferred for pipeline construction. Two thirds of the network already consist of ductile iron pipes. Quality material, a long working life and the good hygiene properties for drinking water all speak in favour of the cast iron pipe system. "Quality counts", says water engineer Werner Drolle with satisfaction. Also the service of Tiroler Rohre GmbH was convincing: "There was never any waiting time between deliveries, so the construction work progressed quickly without delays."

Products from the home market preferred

Whenever possible, the municipality goes for home-produced products. So the added value stays in Austria. When selecting products, it is not just a question of the cheapest price – but of the quality. "The price-performance ratio must fit," explains Feldkirchen's deputy mayor Siegfried Huber. Added to this is the fact that with good support by experienced sales representatives, smooth progress of work is guaranteed.



Feldkirchen's deputy mayor Siegfried Huber speaks up for very good maintenance of the town's drinking water system.

Meanwhile, 5,750 m of TRM cast iron pipes – and 4,000 m of them during last year alone – has been laid in the Feldkirchen network of pipelines. "We will also be relying on TRM products in the future," says the deputy mayor contentedly. In this year too, work is envisaged on the drinking water pipelines – meaning that another kilometre of ductile iron pipes will be inserted into the network.

Keywords

Maintenance, renewal, subsidies, pressures and volumes, crossing the railway line, resident number/supply area ratio, ductile iron pipes

Author

Patricia Pfister

Editor Print and Online
Fachmagazin zek kommunal
Brunnenstraße 1
A-5450 Werfen
pp@zekmagazin.at
www.zek.at

Contact

Tiroler Rohre GmbH

Igor Roblek

Innsbrucker Str. 51
A-6060 Hall in Tirol
Phone: +43(0)664 4008848
igor.roblek@trm.at
www.trm.at

Patricia Pfister

Installation of a sewer pipe on a steep slope

Drainage for a scattered settlement in the Carnic Alps

Investments for tourism

Framed by the idyllic backdrop of high mountain peaks, justifiably termed a snow haven because of the abundant snowfalls from December to April while also being blessed with an average of 850 hours of sunshine in the Winter season, making it one of the ski resorts with the most hours of sunshine in the Alps: this summarises why the Nassfeld in the Carnic Alps attracts tourists in their thousands every year. But the Carinthia region not only draws Winter sports enthusiasts but also hikers and nature lovers in Summer. With 1.4 million overnight stays a year – and the trend is upward – it is no wonder that communities and investors in the region want to develop yet more tourist structures and/or extend existing ones.

An essential precondition if any major building projects can be achieved at all is a well-functioning water supply and wastewater disposal system. At the Nassfeld and in the Tröpolach, further projects are planned in the coming years. Wastewater from properties on the Italian side of the border region is already being handled by the Carnic region wastewater association which is responsible for the Nassfeld.

Drainage for a scattered settlement

Actually, the drainage of the scattered settlement with 25 properties at the Guggenberg is no longer part of the area of responsibility of the Carnic region wastewater association. But because of the touristic development to be expected, the lack of alternatives and the



Carving the way downwards: the construction of the new wastewater pipe from the scattered settlements on the Guggenberg to the existing wastewater network was only possible with a hydraulic excavator with walking legs and a winch securing device.

unequal distribution or increased occurrence of wastewater in specific months, it was decided to connect the outlying properties to the wastewater network of the Carnic region wastewater association. For this, a straight-line route was selected which runs over a length of 1.5 km and steep terrain with a gradient of up to 45° to the existing wastewater network.

A construction project holding many challenges, but the alternatives – individual or group sewage treatment plants – would have had an unsatisfactory result. *“If no permanent, uniform feed is available, this will be complicated by individual treatment plants. The utilisation rate in the Summer and Winter months is extremely high in the Carnic region disposal area and very low in the off-season”,* explains engineer Martin Enzi, managing director of the wastewater association. *“As we are an area which is very much dominated by tourism, there are great*

fluctuations: from a basic population equivalent of 17,000 to peak-load phases of over 40,000 population equivalents when it comes to season-related levels”.

Another option would be a route for the pipeline which runs along the 4.5 km long access road which snakes its way upwards like a switchback. However, the length here was scarcely able to be financed. So, with the direct outlet, the shortest route was chosen, being only one third of the length. *“The solution with thrust and tractive restrained ductile iron pipes quickly became clear,”* says engineer Walter Brieger, who was commissioned with the planning of the construction work.

Cement mortar coating protects the pipes against external factors

The wastewater pipeline overcomes some 400 vertical metres. From 1,000 m above sea level it runs from the properties to be drained directly down to the wastewater system at about 600 m above sea level. In doing so it crosses some very different alpine zones. The requirements placed on the pipe material used were accordingly high, which is why the decision was made for robust ductile iron pipes with the VRS®-T push-in joint in nominal size DN 80 from Tiroler Rohre GmbH. These score even more points on account of the abrasion resistance of cement mortar lining, which is guaranteed even at the high flow speeds which occur on steep slopes.

A criterion of quite particular importance which had to be taken into account was resistance to external factors. So the wastewater pipeline had to withstand even potential landslides. Because of the complicated geological conditions and the special geographic and tectonic position – as the Eurasian Plate meets the African Plate in the Carnic Alps – various precautions had to be taken.

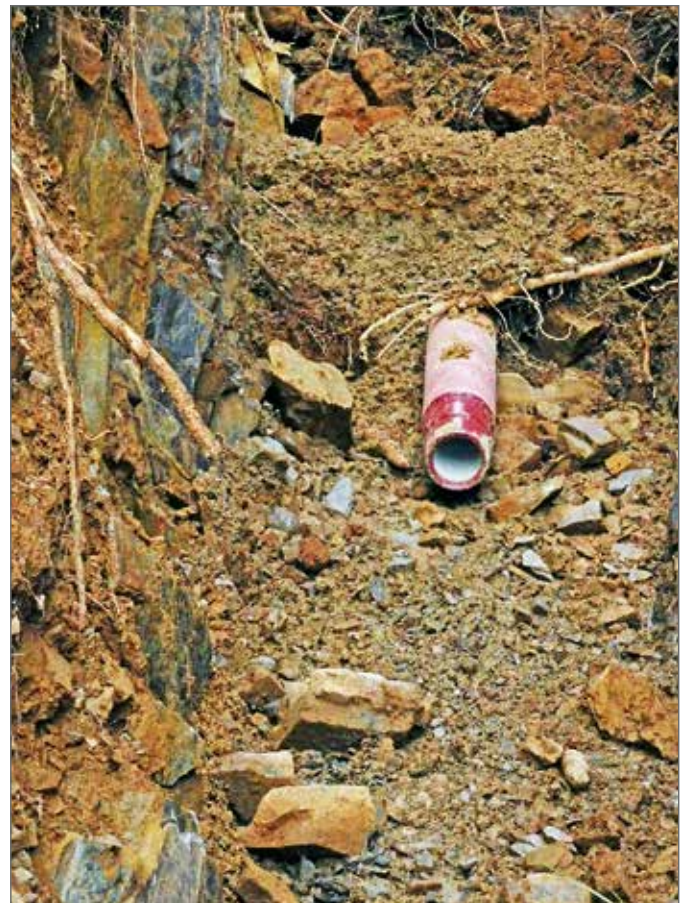
The bedding of the pipes in conventional bedding material was not possible in this steep terrain, which is why ductile iron pipes with cement mortar coating were used. The coating provides reliable protection against e.g. rockfalls during installation which could damage the pipe. Thanks to the VRS®-T restrained push-in joint, there was no need for additional thrust bearings. The constant

movements of the mountains in the tectonically sensitive region make it necessary to use expansion compensation (long-sleeve sockets), developed by Tiroler Rohre GmbH – a proven method for compensating for mountain movements such as landslides. *“As a particular safety measure, expansion compensators (long-sleeve sockets) have been installed to allow the pipe to expand to some extent without resulting in a pipe break”*, explains Martin Enzi.

As the experience with cast iron pipes from Tiroler Rohre GmbH is consistently positive, it was decided to opt for the robust material of the traditional Austrian manufacturer throughout the challenging pipeline construction on the association’s territory. But it was not only the wastewater association who gathered experience from the construction



In order to protect ductile iron pipes against external factors, pipes with cement mortar coating were used. Delivering the usual pipe-bedding material on the steep slope was not possible.



The geological and tectonic conditions in this region make it prone to landslides. The use of ductile iron pipes with cement mortar coating was therefore a “must”.



The 1.5 km long section of the wastewater pipeline climbing up the steep gradient. Because of its striking blue colour, the excavator can be spotted on the aisle through the forest.



The „spider“ not only dealt with the earth-moving work but it also transported the pipes.



Ductile iron pipes with the VRS®-T restrained push-in joint earn extra points with the abrasion resistance of cement mortar lining, which is guaranteed even at the high flow speeds which occur on steep slopes.

projects implemented; the pipe manufacturers too gained some knowhow from this for further projects: *“We, as pipe manufacturers, also learn from such construction projects and can apply our knowledge in other high-Alpine regions of Austria where similar conditions arise. Hence we move with the times and, based on our experiences, can drive the develop-*

ment of new products, such as the long-sleeve socket”, explains the sales representative from Tiroler Rohre GmbH, Dr. Igor Roblek, who looked after the wastewater association.

Excavation work on the extremely steep gradient

The greatest challenge when constructing the wastewater pipeline was without doubt the earth-moving work and the transport of the pipes on the extremely steep gradient. The installation of the pipes was only possible with a so-called “spider”. This machine, also known

as a walking excavator, differs from conventional hydraulic excavators in the construction of the undercarriage. It does not have the usual wheel drive but, as its name suggest, is equipped with four walking legs. On the legs there are both wheels and outriggers. With the help of these independently controllable walking legs, it is also possible for the driver to carry out operations even in difficult terrain. But even with the equipment constructed for challenging earth-moving work, both the managing director of the wastewater association and the planning engineer had misgivings about its feasibility – despite decades of experience in the high-Alpine region, neither knew of a construction site of comparable steepness.

The starting signal was given by the equipment operator from the Porr-Seiwald consortium commissioned for the work, who was taking up the challenge with the “spider” and an additional winch securing device. So a trench was able to be excavated for the pipes in the conventional way, without the need for cost-intensive boring into the rock. The pipes were also transported with the walking excavator. *“They used very experienced operators who work with excavators and can handle these pipe bundles”,* says Walter Brieger approvingly. *“It’s hard work, managing the transport in such terrain”.*

Logistic challenges

The construction logistics also faced the clients and planning engineers with some major challenges, since the hoteliers feared falling guest numbers and dissatisfied visitors. So wherever possible the building work was pushed forward quickly in the low season. In addition, the fittings needed were delivered by Tiroler Rohre GmbH without delays. *“The company structure of TRM with sales representatives in the individual Federal States and the strong regional presence of sales partners makes it possible for us to deliver the required pipes plus all the fittings needed promptly and precisely. So, for over 70 years now, we have been a reliable partner for our clients all over Austria”,* says Dr. Igor Roblek from Tiroler Rohre GmbH.

Secure operation for many decades

The work of constructing the entire 5.5 km long pipeline took a little over one year; 1.5 km of this is the length of the section of wastewater pipe described on the steep gradient. Both Martin Enzi and Walter Brieger are relieved at the outcome of this challenging project and hope that they do not have to repeat such difficult work.

Even if the rather lackadaisical motto “buried and forgotten” does not apply with the Carnic region wastewater association, it is assumed that there will be problem-free operation for many decades. For this reason, top quality pipe material is all the more important here. Luckily, ductile iron pipes promise a long working life.

Keywords

Carnic Alps, pipe-laying on a steep slope, drainage for a scattered community, long-sleeve socket, DN 80 ductile iron pipes

Author

Patricia Pfister

Editor Print und Online
Fachmagazin zek kommunal
Brunnenstraße 1
A-5450 Werfen
pp@zekmagazin.at
www.zek.at

Contact

Tiroler Rohre GmbH

Igor Roblek

Innsbrucker Str. 51
A-6060 Hall in Tirol
Phone: +43(0)664 4008848
igor.roblek@trm.at
www.trm.at

Ivan Demjan und Petr Krejčí

Installation of a DN 600 drinking water culvert under the Nežárka river

Horizontal directional drilling process for DN 600 ductile iron pipes in the Czech Republic

The Chotýany-Zlukov drinking water supply pipeline, which is operated by the South Bohemian water association, Jihoeský vodárenský svaz, is one of the most important transport pipelines of the region. Close to Veselí nad Lužnicí it crosses the River Nežárka as an above-ground pipeline, suspended from a steel bridge. This disadvantages of running this pipeline above ground were particularly clear when, in 2002, flooding caused the mass of water to dam up under the bridge construction. Faced with the resulting very limited working life of the bridge as well as the considerably higher maintenance expense and increasing vandalism, the people responsible decided to lay the drinking water pipeline under the river.

Data on the culvert

The question of the crossing beneath the Nežárka was solved with the construction of a culvert, into which the 71 m long pipeline of DN 600 ductile iron pipes, supplied

by Duktus litinové systémy s.r.o (GmbH), was pulled using the trenchless horizontal directional drilling (HDD) technique. The total length of the drilling, including the pilot bores, was 113 m. The curve in the culvert benefitted from the flexibility of the socket joints of 2 degrees in each case. A decisive factor here is that, with this installation technique, the high flexibility of the socket joints means that, at the same time, they can also withstand the high tractive forces which occur while the pipes are being pulled in by the drilling rig.

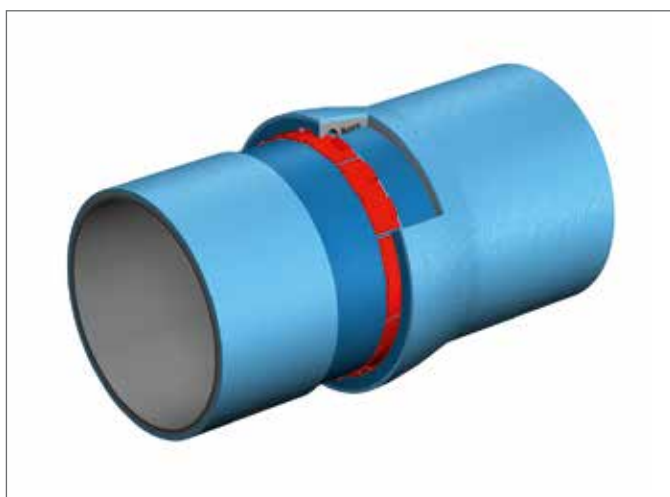
For the DN 600 ductile iron pipes with BLS® restrained push-in joints used, tractive forces of up to 1,525 kN are permissible. The external diameter of the joints is 742 mm; the positive-locking joint with welding bead and locking segments withstands an operating pressure PFA = 32 bar.

From the requirements listed, it was evident that the assessment of the suitability of a pipe system for a water pipeline based on the planned operating pressure

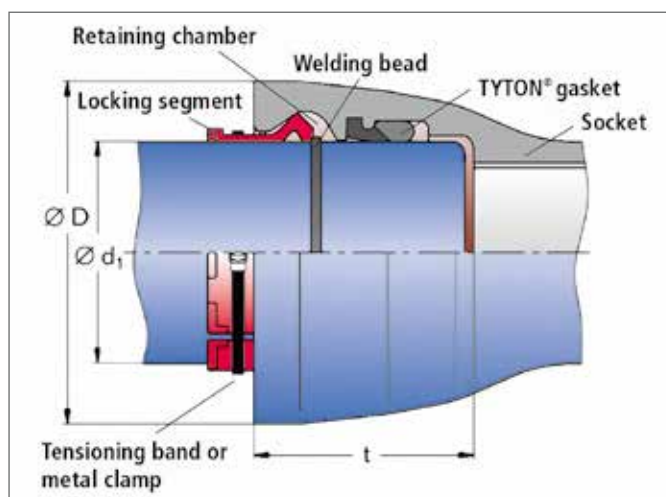
alone is not sufficient but that other criteria influence the quality and durability of a water supply system. So, with the use of trenchless technologies for example, it is necessary to select a pipe system with high-quality mechanical external protection and also strong corrosion protection. Therefore, ductile iron pipe with fibre-reinforced cement mortar coating were used as this protects the pipe against mechanical damage when it is being pulled through in the trenchless technique. The sockets of all the joints are protected with a rubber or thermoshrink sleeve and a sheet metal cone, which prevents the rubber sleeve from being stripped away and grinding damage being caused to the socket.

Data on the HDD process

The pipe string was pulled in with a special pull-in head to fit the shape of the socket. It is longitudinally positive-locked by means of locking segments to the welding bead of the first pipe.



Assembly of the DN BLS® restrained push-in joint.





With a "Ditch Witch JT60", between the bore was widened in stages to 400 mm, 500 mm, 700 mm and finally to 950 mm.



Connection of the upsizing head to the DN 600 pipe pull-in head.



Function testing of the drilling head before pulling in the pipes.



Pulling the pipes into the borehole.

An important parameter which has a considerable influence on the success of the horizontal directional drilling technique is the geological composition and condition of the subsoil at the installation site. Here, at the Nežárka crossing, the basic conditions were complicated: on the starting side there were deposits of loose river sediment as far as the slightly weathered paragneiss at a

depth of around 3 m and then hard granite. On the opposite, target bank, which lies approx. 2.5 m lower, there were also deposits of loose river sediment, but to a considerably greater depth. The profile beneath this is similar to that on the starting side. The groundwater level is at a depth of approx. 1.2 m. According to the planning, from the starting side the drilling would be through the hard

rock strata; at about halfway across, the drilling would be through the sandy river sediment.

Driving and widening in 11 days

The drilling work began on 13 April 2018. With a "Ditch Witch AT30" horizontal drilling rig (with a maximum pulling force of 150 kN) the



In the background: the ageing drinking water pipeline routed across the Nežárka bridge; in the centre: starting pit and the pipe string ready and waiting to be pulled in.



The pipe string was pulled through in one piece.

pilot bore was driven with a roller bit and then widened to 300 mm in a second drilling process.

Using the considerably larger drilling machine, a "Ditch Witch JT60", between 17 and 23 April 2018 the bore was widened in stages to 400 mm, 500 mm, 700 mm and

finally to 950 mm. For the widening process, the engineers used a Kodiak type borer, which has a high rotation weight allowed the carbide blades to drill evenly through relatively hard rock (in this case paragneiss and granite). The largest drilling head used weighed 1½ tonnes.

Problems during the drilling work occurred at the transitions from the relatively soft, weathered paragneiss to the much harder granite. But – despite the large pipe dimension – the experienced team even had this problem well in hand over the last 5 m of the drilling.

Crucial tasks of the drilling fluid

In order to be able to pull in a DN 600 ductile iron pipe with an outside socket diameter of 742 mm, an opening of approx. 950 mm is necessary. The volume of a borehole with a diameter of 950 mm and a length of 71 m corresponds to 50 m³. So that the pipe string can be drawn through the borehole, this volume of earth has to be transported to the starting and target pits in each case! The borehole has to be cleared as far as possible during each individual widening process, and this is the main task of the drilling fluid. This mainly contains bentonite and additives which, depending on the type of ground, are added to achieve better transporting properties. At the same time the drilling fluid helps with the stability of the borehole during widening and during the pulling-in of the pipes. Correctly used drilling fluid determines the success of the pipe pulling to a large extent.

As is usual with civil engineering work, the piping system has the lowest influence on the overall costs of a project. A particular feature of the HDD process is that the highest costs result from the use and repeated preparation of the thixotropic bentonite suspension; and so it was in this case.

During the stage-by-stage widening of the borehole to the diameters of 500 mm, 700 mm and 950 mm, in total around 350 m³ bentonite was used for the drilling fluid, which could then be sent to a recycling plant for reuse.



A view over the construction site to the right and left of the Nežárka.

A premiere under difficult framework conditions

The widening was completed on 23 April 2018, so that on the following day the DN 600 mm ductile iron pipes could be pulled in. For this, the pipes were preassembled and successfully pulled through in one piece without problem.

With this successfully completed project, the South Bohemian water association had solved a burning problem: by the construction of a culvert under the Nežárka, the essential drinking water pipeline could be protected from flooding, vandalism and other disrupting influences and the undisturbed supply of an entire region could be ensured.

It is not without pride that the responsible members of the association regard the fact that this was the first project in the Czech Republic in which ductile iron pipes have been installed using the horizontal directional drilling technique to drill under a river – and this under quite difficult conditions.

Keywords

Culvert construction, Czech Republic, drinking water pipeline, HDD technique, crossing under a river, DN 600 ductile iron pipes

Authors

Ing. Ivan Demjan

TALPA-RPF s.r.o (GmbH)
Holveckova 645/36
CZ-718 00 Ostrava-Kunčičky
www.talparpf.cz

Ing. Petr Krejčí

Duktus litinové systémy s.r.o
(GmbH)
Růžová 1386
CZ-252 19 Rudná
www.ductus.cz

Matthias Müller and Boris Vaihinger

Renewal of drinking water treatment at the Sindelfingen waterworks

Each year, for its approximately 60,000 residents and all of its industrial companies, Stadtwerke Sindelfingen GmbH feeds around 4.5 million cm³ into its network. Despite the relatively high hardness of the groundwater used, there is no need for any softening in the water treatment process: The water, which is pumped up from a depth of 120 m, is mixed with water from Lake Constance and thus achieves a consumer friendly level of hardness. The purpose of water treatment is to filter out the turbidity (mineral and organic substances) which occurs in rare cases after heavy rainfall and snow melts and to exclude other external negative impacts.

Modernisation for the future

According to its company philosophy "think global – act local", ecological considerations are an essential part of the strategy concept of the Sindelfingen municipal utilities (Stadtwerke Sindelfingen GmbH). One of these ecological considerations concerns the Sindelfingen waterworks: since its construction in 1977 it had started to age and was in need of thoroughgoing renovation. Under the leadership of Dipl.-Ing. Carolin Bormann and water engineer Michael Suffner,



Sindelfingen waterworks.

three different items of drinking water treatment equipment were renovated and/or optimised.

ERHARD TWIN-AIR admission and release valve

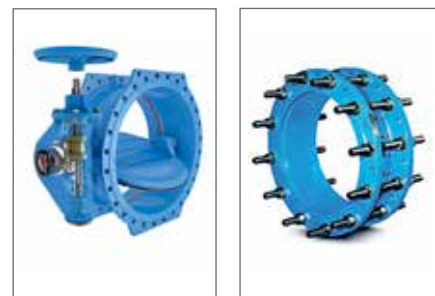


So now, for example, filtration no longer happens in multi-layer filters but in single-layer filters. The corrosion protection of the vessels was renewed and most of the new valves required and installed here were obtained from ERHARD GmbH & Co. KG. On the new single-layer filters, which are stocked with quartz sand and with activated carbon, TWIN-AIR air admission and release valves are now operating, for example to discharge just about 100 m³/h of air safely and securely during air purging.

Thanks to its large cross-section and the very high air admission and release speeds, TWIN-AIR air admission and release valve is perfectly suited for use in larger pipe networks and at all times guarantees safe and automatic air admission and release for the pipeline during filling, during operational air release and during the drainage process. Despite the high performance, its construction is compact and space-saving. The valve has two nozzles .

During the filling of a pipeline, the air can first of all flow out through the large nozzle, which means a high venting output. When the water level reaches the floating point of the two balls, the nozzles are closed. However, if air accumulates during ongoing operation, only the float ball of the small nozzle drops down and thus releases the small valve until the volume of air has flowed out. With each switching process, the small nozzle is cleaned by means of a patented cleaning device.

Double-eccentric butterfly valves, dismantling joints



A large number of ERHARD ROCO wave double-eccentric valves of nominal sizes DN 100 to DN 300, pressure stage PN 16, with slider crank mechanism and with integral electric drive and/or with handwheel, for the most part with corresponding dismantling joints (ERHARD PAS10), have also been installed.

The flow-optimised valve discs and internal body contours offer stability yet maximum efficiency in every size. The slider crank gearbox is perfectly adapted to the torque curve of the valve disc and so reduces permissible pressure surges; the polygon plug-in connection transmits driving forces reliably without play and



Single-layer filter vessels with TWIN-AIR admission and release valve in position.



PAS10 adaptor and spacer, ERHARD ROCO wave butterfly valves with integral electric drive.

flutter. High-quality EKB epoxy and enamel coatings plus a broad range of special coatings ensure lasting protection.

The butterfly valves with the patented wave design offer optimum energy efficiency and hence significant energy savings.

The ERHARD PAS10 is equipped with two flanges and one pressure ring. The design allows optimum control of the sealing action. This construction makes it possible to reduce the number of threaded rods as these only have a bracing function. The ERHARD PAS10 is equipped with 25 % threaded rods for pressure stages PN 10 and PN 16 and with 50 % threaded rods for pressure stages PN 25 and PN 40.

Soft seated Multamed gate valve



In the widest variety of inlet and outlet pipelines, new soft seated ERHARD Multamed gate valves have been. The construction of this generation currently offers a decisive plus-point: after it opens, the wedge is entirely outside the passage, meaning that medium flow is not constricted.

Additional plus points are:

- the plugged spindle bearing with bayonet fittings, which allows the seamless coating of the cover for continuous corrosion protection
- the maintenance-free and medium-free sealing of the spindle bearing with O-rings
- the rolled thread of the spindle counteracts deposits
- the new type of dirt cap with integrated sealing lip for secure sealing against dust and moisture, and
- optimal corrosion by EKB epoxy to GSK specifications or by enamel

Even before this project, Stadtwerke Sindelfingen already had good experiences with ERHARD valves as regards service, reliability, maintenance and, not least, cost.

Authors

Matthias Müller

Product manager
 ERHARD GmbH & Co. KG
 Meeboldstraße 22
 D-89522 Heidenheim
 Phone: +49(0)7321 320-217
 mmuellertr@talys-group.com
 www.talys-group.com

Boris Vaihinger

Sales representative
 Baden-Württemberg
 ERHARD GmbH & Co. KG
 Meeboldstraße 22
 D-89522 Heidenheim
 Phone: +49(0)7321 320-217
 mmuellertr@talys-group.com
 www.talys-group.com

Matthias Müller

A new generation of underground hydrants

Maximum performance for maximum security

With the new generation of underground hydrants, ERHARD GmbH & Co. KG in collaboration with the BAYARD company from France is bringing a revised design in two versions onto the market. PREMIUM with a PUR cone and fully enamelled casing pipe and STANDARD with an EPDM cone and EKB epoxy coated casing pipe are the names of the two versions, which offer maximum performance for the maximum security.

PREMIUM DN 80 underground hydrant with PUR cone, enamelled

The hydrants of the new generation have numerous well thought out construction features which guarantee the user even more reliable operation and maximum security. Hence the shut-off cone is joined to the valve insert pipe by a secure bolt connection and so provides a reliable in the enamelled seating of the lower part of the column. Polyurethane (PUR) is a high-molecular organic material with a chemical structure characterised by a high number of urethane groups. Within determined temperature limits it therefore has the characteristic elastic properties of rubber and is therefore used in products under very high mechanical stresses. For its use in hydrants it stands out above all because of the very high tensile strength and elongation at break on the one hand and the low water uptake on the other hand.



DN 80 PREMIUM underground hydrant.

Further advantages of the PUR cone:

- The material has an extremely high abrasion resistance and hence minimal wear (as shown in numerous long-term tests).
- Not sensitive to soiling in the cone seat; full tightness (especially in case of surface distortion due to foreign bodies) is guaranteed at all times and the working life is considerably increased thanks to the excellent resilience.
- Very good tear strength, considerably higher than with comparable elastomers; extension of material damage therefore only to a very low extent.
- Very high ageing resistance; this also means that leaks due to crack formation or brittleness are avoided over very long periods of use.

- Good sliding characteristics on account of the low friction coefficient; therefore only low torque values required for opening and closing.
- Meets all requirements according to DVGW W 270 [1] and KTW guideline [2] and is free of plasticisers and fillers.

Corrosion protection of the casing pipe: permanently protected with ENAMEL

The PREMIUM design underground hydrant is offered with a fully enamelled casing pipe for perfect corrosion protection. The particular properties of enamel have been known for around 3,500 years when the first pieces of jewellery were made with it. And still today, enamel is indispensable as a technical material for industrial applications. When fired at around 720 °C it presents itself as a glasslike, high-strength material which forms a permanent and inextricable bond with the metallic substrate. ERHARD enamelled valves have a special fibre enamel with short fibres in the material which prevent the enamel from cracking in case of damage.

Enamelling in accordance with DIN 51178 [3] offers numerous advantages:

- Safely protected from possible infiltration
- Absolutely impervious to vapour and oxygen
- Stable bonding even under bending of the material and other loads
- High elasticity
- Resistant to acids, alkalis and neutral organic media

- Extremely temperature resistant, can be used without problem even with sudden temperature fluctuations
- Good resistance even with abrasive media due to high hardness of 600 HV
- Even with soil class III, no further protection measures necessary
- Extremely smooth surface (Ra 0.05) for hygienically impeccable conditions
- No fixing of mineral and/or organic elements (no growth of incrustations to reduce the cross-section)
- Ideal mating surface for elastomer seals
- Extremely durable and long-lasting, no embrittlement and chalking
- High environmental compatibility



DN 80 STANDARD underground hydrant.

Corrosion protection of the casing pipe: permanently protected with EKB coating

The company has extensive experience and many years of know-how in the complex process technology of enamelling. A modern enamelling plant allows flexible but high-quality production as all the stages of enamelling with ERHARD Pro-Email – from degassing-annealing, blank blasting, applying the frit through to firing and cooling – are seamlessly monitored.

The ERHARD DN 80 PREMIUM underground hydrant is available in the design with flange connection with the reliable claw cover in plastic, with and without double closure.

STANDARD DN 80 underground hydrant, EPDM cone, EKB epoxy

As compared with the PREMIUM underground hydrant, the STANDARD underground hydrant designed with an EPDM cone according to KTW guideline [2] and DVGW W 270 [1] – instead of PUR – and the casing pipe coated with epoxy-plastic (EKB) – instead of enamel.

The STANDARD design is seamlessly protected by cathodic dip-coating inside and out. Cathodolysis is an electrochemical process in which the workpiece is coated in a dipping bath. The coating thickness is around 50 µm. The process is also used to ensure corrosion protection in vehicle production, i.e., it is extremely suitable for complicated contours. The most important properties are:

- In accordance with EN ISO 2808 [4]: impact strength 5 Nm (EN ISO 6272-1) [5], 1 kg falling weight, height 50 cm, no cracks
- Salt spray test: 500 hours corrosion resistance (EN ISO 9227) [6], no bubble formation
- Adhesion with the cross-cutting test: 0, no separation of the coating
- Threads are included in the dipping process and so also protected against corrosion

Particularly with the subsequent EKB coating, the result for this combination is an absolutely sure protection against corrosion. The total thickness of the powder coating applied is at least 250 µm.

Naturally, the new generation corresponds to EN 14339 [6] for underground hydrants; both alternatives have the DIN-DVGW type approval certificate for drinking water and the CE label.

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Author

Matthias Müller

Product manager
ERHARD GmbH & Co. KG
Meeboldstraße 22
D-89522 Heidenheim
Phone: +49(0)7321 320-217
mmuellertr@talys-group.com
www.talys-group.com

Ursula Vogler and Oliver Jäger

How to explain the function of a control valve?

Making the invisible visible

The presentation of technical products can be a challenging task for companies. On the one hand it is not merely the component that has to be represented, but also the interplay between components and hence their function. On the other hand, the advantages and particular features of the product have to be illustrated and singled out. Not least, everything has to be expressed in different language. Naturally, the presentation of technical products should also excite the curiosity and attention of the client and “sweep him away”.

Moving pictures

Dry technical texts alone do not do the trick here. But pictures! A picture speaks more than a thousand words – but a picture is also only a momentary snapshot. The interplay of components can only be illustrated if the components are moving.

Therefore the unanimous answer to the question of how the new RKV type 7015 plunger valve should be presented to clients on the occasion of IFAT 2018 was quite simple: with moving pictures! Because a film can best demonstrate the many carefully thought-out details of the Düker plunger valve.

Making the invisible visible

Unfortunately, however, a real film has to be ruled out because a plunger valve only functions when it is integrated into the closed water pipeline with water flowing through it.



Components of the Düker RKV type 7015 plunger valve.



Longitudinal section through the RKV type 7015 plunger valve.



RKV type 7015 plunger valve with Düker slider crank mechanism and handwheel.

A popular children’s TV show in Germany “Sendung mit der Maus” (the programme with the mouse) offered the concept: “Here we can see nothing at all – let’s change it around it so we can...”

As we can apparently only make the invisible visible by “changing it around”, a virtue was quickly

made out of necessity and all the possibilities of modern CAD-based simulation were used. The construction data created by Düker for the new plunger valve were the basis on which the Sven and Björn Pfister from the Geminus 3D company in Gemünden/Main produced a fascinating and inspiring animation.

The quality of the animation with

- photorealistic surfaces,
- the true-to-detail simulation of water movements,
- the skilful emphasising of important details and not least
- some powerful music to which the scenes were accurately adapted to the scenes,

also reflects the quality and the advantages of the Düker plunger valve. These are:

- an optimum control range and extremely soft closing thanks to the slider crank movement of the plunger, which is also supported by the Düker slider crank gearbox,
- secure main sealing in the form of a robust profile sealing ring on the plunger and an O-ring in the valve body, which are intelligently positioned to avoid unnecessary wear,



Hygiene safety by systematic flushing of the plunger.

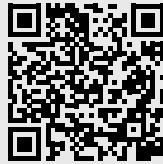
- hygienic security by means of systematic flushing of the plunger and a secure shaft seal,
- a long working life on account of robust, carefully positioned guide beads and wear directed at the rotatable and easily replaceable plunger,
- no cavitation damage to the valve and pipeline, because cavitation can occur harmlessly in the middle of the pipe.

In the context of this animation it was of course important not merely to produce beautiful pictures but also to represent the technique and function of the product correctly.

It is a real delight to present the advantages of the plunger valve to clients and interested parties with the help of the animation.

Therefore we would like to recommend that you convince yourself of the quality and advantages of the Düker plunger valve!

YouTube link for mobiles:



There are other links to films about Düker published on YouTube at www.dueker.de/film

Authors

Ursula Vogler

Düker GmbH
Würzburger Straße 10-16
D-97753 Karlstadt/Main
Phone: +49(0)9353 791-289
ursula.vogler@dueker.de
www.dueker.de

Oliver Jäger

Düker GmbH
Hauptstraße 39-41
D-63846 Laufach
www.dueker.de

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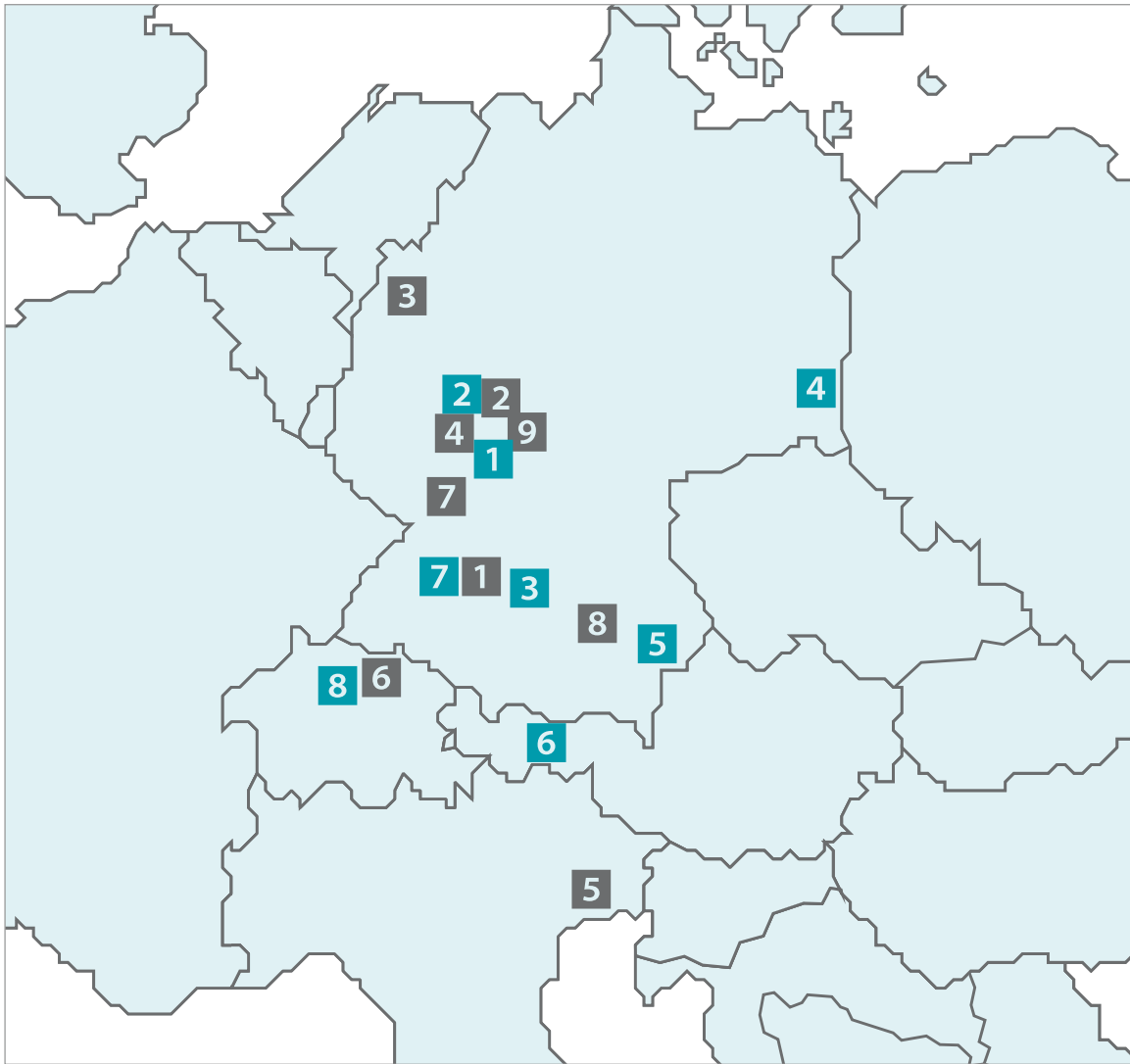


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European Association for Ductile Iron Pipe Systems/ Fachgemeinschaft Guss-Rohrsysteme e. V.
Doncaster-Platz 5
45699 Herten/Germany

Telephone: +49 (0)2366 9943905

Fax: +49 (0)2366 9943906

E-Mail: info@eadips.org

Editorial staff

Dipl.-Ing. Christoph Bennerscheidt

Dr.-Ing. Jürgen Rammelsberg

Dr. Gabriele Hahn

Editor

Dipl.-Ing. Christoph Bennerscheidt

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