DUCTILE IRON PIPE SYSTEMS

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Topics and Authors

Brief des Herausgebers

Liebe Leserinnen und Leser,

die Auswirkungen des Klimawandels waren in den Jahren 2018 und 2019 in Europa deutlicher sichtbar als je zuvor und sie führen uns vor Augen, dass gehandelt werden muss. Auf der einen Seite müssen unsere Städte und die Infrastrukturen widerstandsfähiger werden. Auf der anderen Seite muss auf allen Ebenen der Ausstoß von klimaschädlichen Gasen, vor allem CO_2, reduziert werden; möglichst ohne Verzicht auf die gewohnten Annehmlichkeiten. Hinzu kommt, dass die Umstellung von der Linearen Wirtschaft über die Recyclingwirtschaft hin zur Kreislaufwirtschaft vorangetrieben werden soll. Die Mitglieder der EADIPS FGR haben bereits frühzeitig begonnen, ihre Produktionsprozesse in Richtung Kreislaufwirtschaft umzustellen und dabei auch den CO_2-Ausstoß zu reduzieren.

Moderne und dauerhafte Umhüllungen stellen sicher, dass duktile Guss-Rohrsysteme in alle Böden eingebaut werden können. So kann beispielsweise das Schwammstadt-Prinzip im Leitungsgraben umgesetzt werden, oder Leitungen können im ausgehobenen Material gebettet werden, weil Zementmörtel-Umhüllungen einen ausreichenden mechanischen Schutz sicherstellen. Einfach ausgedrückt bedeutet das: Für jede Bettung gibt es das passende Rohr aus duktilem Gusseisen!

Auch bei der Produktion von CO_2-neutralem Strom in Wasserkraftwerken mit großen Höhenunterschieden oder unter schwierigen Einbaubedingungen sind leicht zu montierende, variable und schubgesicherte Guss-Rohrsysteme die erste Wahl. Aus demselben Grund hat sich ihr Einsatz in Anergienetzen bewährt, bei denen die in großen Binnenseen gespeicherte Wärmeenergie nutzbar gemacht wird. Duktile Guss-Rohrsysteme bieten die besten Voraussetzungen und leisten damit einen Beitrag zur CO_2-Reduzierung.

Eine besondere Herausforderung stellen Planung, Bau und Betrieb von oberirdischen temporären Bypass-Leitungen, sogenannte Interimsleitungen, dar. Diese Art der Nutzung und Verlegung mit ihren speziellen Anforderungen ist bisher nicht genormt. Einen Blick in die „Schreibwerkstatt“ für Werksnormen in Berlin erlaubt der Beitrag über innerstädtische großdimensionierte Interimsleitungen.

Lassen Sie sich inspirieren!

Es grüßt Sie herzlich

Christoph Bennerscheidt

Letter from the editor

Dear Readers,

the effects of climate change have been more visible in Europe in 2018 and 2019 than ever before, reminding us that action is needed. On the one hand, our cities and infrastructures must become more resilient. On the other hand, the emission of climate-damaging gases, especially CO_2, must be reduced at all levels; if possible without sacrificing the accustomed amenities. In addition, the transition from a linear economy to a recycling economy to a circular economy is to be promoted. The members of EADIPS FGR began years ago to convert their production processes towards a circular economy and in doing so also to reduce CO_2 emissions.

Modern and durable coatings ensure that ductile cast iron pipe systems can be installed in all soils. For example, the sponge city principle can be implemented in the pipe trench, or pipes can be embedded in the excavated material because cement mortar coatings ensure adequate mechanical protection. Put simply, this means: There is a suitable ductile cast iron pipe for every bedding!

Even when producing CO_2-neutral electricity in hydroelectric power plants with large heads of water or under difficult installation conditions, easy-to-install, variable and restraint cast iron pipe systems are the first choice. For the same reason, their use in energy networks has proven itself, where the thermal energy stored in large inland lakes is made useable. Ductile cast iron pipe systems offer the best conditions and thus make a contribution to CO_2 reduction.

The planning, construction and operation of above-ground temporary bypass pipelines, so-called interim pipelines, represent a particular challenge. This type of use and installation with its special requirements has not been standardised to date. The article on inner-city, large-dimensioned interim pipelines allows a look into the "writing workshop" for in-house standards in Berlin.

Let yourself be inspired!

Warmest greetings

Christoph Bennerscheidt

Schnellübersicht / Abstracts

Jahresbericht 2019 und Ausblick 2020

Manfred Künze, Christoph Aigner und Christoph Bennerscheidt

Im Bewusstsein der Menschen ist der Klimawandel zum alles beherrschenden Thema geworden. Es bleibt zu hoffen, dass die Aktivitäten der Bundesregierung zur Minderung der CO_2-Emissionen bald spürbare Früchte tragen. Das Klimaschutzprogramm hat natürlich dramatische Folgen für die gegenwärtige Struktur unserer Wirtschaft. Einerseits kommt die Stärkung der Kreislaufwirtschaft dem Prinzip des Recyclings in den Gießereibetrieben entgegen, andererseits sind gravierende Investitionen in die Umstellung auf Schmelzaggregate zu schultern, die anstelle von Kohle mit erneuerbarer Energie zu betreiben sind, verbunden mit der dringenden Forderung nach steigender Energieeffizienz und der allgegenwärtigen Aufgabe, Energie zu sparen.

Weitere Verbandsaufgaben liegen in der Betreuung der nationalen und internationalen Regelwerksarbeit, der Fortführung der Gemeinschaftsvorhaben

- Digitalisierung
- Ressourceneffizienz
- Schwammstadt

und der Schaffung einer Gütevorschrift für das RAL-Gütesiegel „Duktile Guss-Rohrsysteme – Rohre, Formstücke und Armaturen (DGR)“ im Fachbereich 8 der GET – Gütegemeinschaft Entwässerungstechnik e. V.

Annual report 2019 and the perspective in 2020

Manfred Künze, Christoph Aigner and Christoph Bennerscheidt

Climate change has become the dominant issue in the people's minds. It is to be hoped that the activities of the German government to reduce CO_2 emissions will soon come to fruition. The climate protection programme will have dramatic consequences for the current structure of our economy. On the one hand, the strengthening of the circular economy accommodates the principle of recycling in foundries, while on the other hand, serious investments have to be shouldered in the conversion to melting units that can be operated with renewable energy instead of coal, combined with the urgent demand for increased energy efficiency and the omnipresent task of saving energy.

Further tasks of the association are the supervision of national and international regulations, the development of joint projects

- Digitisation
- Resource efficiency
- Sponge City

and the creation of a quality specification for the RAL quality label "Ductile cast iron pipe systems – pipes, fittings and valves " in Department 8 of GET – Gütegemeinschaft Entwässerungstechnik e. V.

Gießerei-Industrie = Recycling-Industrie

Mario Mackowiak

Das im Dezember 2019 von der Bundesregierung beschlossene Klimapaket sieht eine Minderung der CO_2-Emissionen um 95 % in allen Sektoren für das Jahr 2050 vor. Eng damit verwoben ist das schon länger bestehende Kreislaufwirtschaftsgesetz, welches geschlossene Stoffkreisläufe für alle Bereiche fordert, so auch auf dem Sektor der Bauindustrie. Die Gießerei-Industrie lebt schon länger dieses Prinzip der Nachhaltigkeit: Gießereierzeugnisse werden bereits heute weitgehend aus Schrott erschmolzen, allerdings noch in großem Maße in Kupolöfen, die erhebliche Mengen an CO_2 emittieren, weil sie ihre Schmelzenergie aus der Verbrennung von Koks gewinnen. Der Trend geht jedoch hin zum Elektro-Induktionsofen, der mit Elektrizität aus erneuerbaren Anlagen betrieben werden

The foundry industry = recycling industry

Mario Mackowiak

The climate package adopted by the German government in December 2019 stipulates a 95 % reduction in CO_2 emissions in all sectors by the year 2050. Closely bound up with this is the law on circular economy, which has already been in existence for some time and requires closed material cycles in all areas, including the construction industry sector. The foundry industry has long been adhering to this principle of sustainability: these days foundry products are extensively smelted from scrap metal, though still to a large extent in cupola furnaces which emit considerable volumes of CO_2 because the energy they require for smelting is obtained from the combustion of coke. But the trend is going towards electric induction furnaces which use electricity

wird. Weitere Aufgaben liegen in der Optimierung aller Prozesse in der Gießerei: so sind z. B. beim Putzstrahlen der Gussstücke erhebliche Energie-Einsparungspotenziale sichtbar. Auch bei der Wiederverwendung der gebrauchten Form- und Kernsande werden weitgehend geschlossene Kreisläufe angestrebt. Seit Langem setzen die Hersteller duktiler Guss-Rohrsysteme mit ihrer langen Nutzungsdauer Maßstäbe für Ressourceneffizienz.

from renewable sources. Additional tasks lie in the optimisation of all processes in the foundry: for example, considerable potential for energy saving can be envisaged when it comes to blasting the castings. And broadly closed circuits can also be achieved by recycling used moulding and core sand. The manufacturers of ductile cast iron pipe systems have long since set the standards for resource efficiency with their long working life.

55 km Trinkwasserleitung über 550 Höhenmeter

Patricia Pfister

Die Mongolei, ein Land der Extreme: Klima, Entfernungen, Bevölkerung, Topographie – nichts erinnert an europäische Gegebenheiten. Allein die Bevölkerungsdichte ist 120 Mal geringer als in Deutschland, die Entfernungen sind gigantisch. Das ist das Feld für ausgeklügelte Logistik, wo es darum geht, eine 55 km lange Trinkwasser-Transportleitung für eine Provinzstadt mit 30.000 Einwohnern zu bauen. Die Verantwortung für Planung, Transport, Bau von Wasseraufbereitung, Pumpstationen und Rohrleitung wurde in bewährte Hände der Tiroler Rohre GmbH gelegt, des österreichischen Herstellers duktiler Guss-Rohrsysteme. So wurden Schnittstellenprobleme vermieden, die sich angesichts eines klimatisch bedingt engen Zeitfensters von sechs Monaten katastrophal hätten auswirken können. Der Beitrag schildert anschaulich, wie sich Extremanforderungen mit duktilen Gussrohren elegant bewältigen lassen.

55 km drinking water pipeline over 550 meters altitude

Patricia Pfister

Mongolia, a land of extremes in terms of climate, distances, population, topography – nothing resembles the conditions in Europe. Population density alone is 120 times lower than in Germany and distances are gigantic. This is an area which needs some ingenious logistics when it comes to laying a 55 km long drinking water transport pipeline for a provincial capital with 30,000 inhabitants. Responsibility for planning and transport, the construction of a water purification plant, pumping stations and the pipeline were placed in the reliable hands of Tiroler Rohre GmbH, the Austrian manufacturer of ductile cast iron pipe systems. Thus, interface problems were avoided which, because of the climate-related narrow time window of six months, could have had catastrophic effects. The article clearly shows how extreme requirements can be elegantly handled with ductile iron pipes.

Innerstädtische großdimensionierte Interimsleitung

Lutz Rau und Jens Große

Seit Langem sind die Berliner Wasserbetriebe Vorreiter bei der Entwicklung und Etablierung neuer Bauverfahrenstechniken. Man denke nur an die Auswechslung bestehender Trinkwasserleitungen, die bereits zur Hälfte grabenlos nach etablierten Technischen Regeln geschieht. Eine ähnliche Entwicklung vollzieht sich gerade bei der Erneuerung bestehender Abwasserdruckleitungen, wo mit Hilfe von temporären Bypass-Leitungen der Abwassertransport aufrecht erhalten werden muss. Für Planung, Bau, Betrieb und Rückbau dieser grundsätzlich oberirdisch liegenden Interimsleitungen sind in den letzten Jahren vielfältige Erfahrungen gesammelt worden, die sich derzeit im Entwurf einer Technischen Regel oder Werksnorm niederschlagen. Als wirtschaftlichste Lösung hat sich auf den geraden Strecken die Verwendung schubgesicherter duktiler Gussrohre herauskristallisiert, die schnell und einfach zu montieren und später zu demontieren sind, die auch bei den weiteren Bauabschnitten erneut wiedereingesetzt werden.

Large-dimension interim pipeline for the inner city

Lutz Rau and Jens Große

For a long time now Berliner Wasserbetriebe has been a pioneer in the development and establishment of new construction technologies. One only has to think of the replacement of existing drinking water pipelines, half of which is already done using the trenchless technology according to established technical rules. A similar development is happening with the replacement of existing wastewater pressure pipelines where sewage transport has to be maintained with the help of temporary bypass pipelines. A broad range of experience has been gathered in recent years for the planning, construction, operation and dismantling of these interim pipelines, which are essentially above-ground, and this experience has been translated into draft technical regulations or standards. The most economical solution which has emerged for straight sections is the use of thrust-resistant ductile iron pipes which are quick and simple to assemble and then dismantle and which can also be used again in other phases of construction. Road crossings are

Straßenquerungen werden als Düker in geschweißter Stahlrohrbauweise ausgeführt. Der Beitrag erlaubt anhand eines in Berlin-Pankow abgewickelten Projekts einen Blick in die „Schreibwerkstatt“ für Werksnormen der Berliner Wasserbetriebe.

achieved by means of culverts using the welded steel pipe technique. Based on a project implemented in Berlin-Pankow, the article allows a glimpse into the “writing workshop” for Berliner Wasserbetriebe’s standards.

Für jede Bettung das passende Rohr

Jürgen Rammelsberg

Der Beitrag enthält eine Zusammenfassung der wesentlichen Technischen Lösungen für den Außenschutz duktiler Guss-Rohrsysteme und schildert die Entwicklung des Regelwerks auf diesem Sektor im Lauf der letzten 50 Jahre. Dabei darf ein Ausblick auf künftige neue Anwendungsbereiche duktiler Guss-Rohrsysteme nicht fehlen: sie sind von hoher Aktualität, weil ein Weg zur Minderung des Klimanotstandes in den Städten aufgezeigt wird, der vom geltenden Regelwerk bereits gedeckt ist (siehe auch den Beitrag „Umsetzung des Schwammstadt-Prinzips“ auf Seite 46 ff.).

The right pipe in the right bedding

Jürgen Rammelsberg

This article provides a summary of the most important technical solutions for the external protection of ductile cast iron pipe systems and describes the development of regulations in this sector over the last 50 years. And of course there is a look at future new areas of application for ductile cast iron pipe systems: they are highly topical because they demonstrate one way of alleviating the climate emergency in our cities, which is already covered by the applicable regulations (see the article entitled “Implementing the sponge city principle” on page 46 ff.).

Herausforderung: Leckortung auf Fernleitungen

Manuel Görzel

Mit dem Korrelationsmessgerät „Ortomat MTC“ der vonRoll hydro (service) gmbh hat sich der Anwendungsbereich der Korrelationstechnik zur Ortung von Leckagen an Wasserdruckleitungen erheblich ausgeweitet. Die bisher typische Messtechnik war auf städtische Trinkwassernetze beschränkt, weil es dort stets leicht erreichbare Zugangspunkte für die Mikrofone gab. Außerdem sind bei derartigen städtischen Netzen die Messstrecken relativ kurz, so dass Leckgeräusche gut detektierbar sind. Anders bei Transportleitungen: Ihre Zugangspunkte liegen oft 1.000 m und mehr auseinander, können untereinander ohne direkten Funkkontakt sein, und Geräusche von Pump- oder Übergabestationen können sich störend bemerkbar machen. Die neuartige Messtechnik überwindet diese Störgrößen und hat sich in der Praxis großer Wasserverbände bewährt.

A challenge: leak detection on long-distance pipelines

Manuel Görzel

With the “Ortomat MTC” correlator from vonRoll hydro (service) gmbh the scope of application of correlation technology for detecting leaks in pressurised water pipelines has been considerably extended. The typical measurement technology previously used was limited to urban drinking water networks as these always have easily accessible application points for the microphones. In addition, with urban networks of this kind, the measurement distances are relatively short so leak noises are readily detectable. But this is not the case with transport pipelines: their access points are often 1,000 m and more apart and may be without any direct radio communication between them; also noise from pumping or transfer stations may have an interfering influence. The new type of measurement technology overcomes these disruptions and has been tried and tested by major water associations.

Qualitätssprung für TRM-Gussrohre

Roland Gruber

Die immense Bedeutung eines gleichzeitig mechanisch und chemisch hoch wirksamen Außenschutzes duktiler Gussrohre ist an anderer Stelle in diesem Heft („Für jede Bettung das passende Rohr“, Seite 28 ff.) bereits dargestellt worden. Es ist deshalb nicht verwunderlich, dass sich ein weiterer Gussrohr-Hersteller mit der Fertigungstechnik der Zementmörtel-Umhüllung auseinandersetzt und nach zwei Jahren intensiver

Quality leap for TRM cast iron pipes

Roland Gruber

The immense significance of external protection for ductile iron pipes which is highly effective both mechanically and chemically has already been described elsewhere in this issue (“The right pipe in the right bedding”, page 28 ff.). It is therefore no wonder that another cast iron pipe manufacturer is grappling with the production technology for cement mortar coating and, after two years of intensive research and

Forschung und Entwicklung ein optimal geschütztes Rohr anbietet. Der Vorteil der „ZMU-Austria“ genannten Umhüllung wird nicht nur in den städtischen Trinkwassernetzen ausgespielt, wo die mechanische Widerstandsfähigkeit eine bedeutend längere Nutzungsdauer im Vergleich zu Kunststoffrohren begründet. Auch im alpinen Bereich bei Leitungen für Wasserkraftwerke und Beschneiungsanlagen ist das duktile Gussrohr mit der Umhüllung „ZMU-Austria“ unschlagbar: So braucht es dort hinsichtlich einer nachhaltigen Wirtschaftlichkeit keine spezielle Logistik für das Bettungsmaterial, da der steinige Grabenaushub einfach und unkompliziert dafür wiederverwendet werden kann. Auch die zunehmende Bedeutung der grabenlosen Einbauverfahren spielt dem neuen Produkt optimal in die Hände.

Die neue Transitleitung für das Birstal

Marco Nussbaumer

In vermeintlich sicheren Versorgungsnetzen können durch den Klimawandel bedingte Wetterereignisse Schwachstellen mit Handlungsbedarf anzeigen. So auch im Kanton Basel-Landschaft, wo im Sommer 2007 sintflutartige Regenfälle im Einzugsgebiet der Birs mehrere Ortschaften überfluteten und das Grundwasser durch Freisetzung von Heizöl und anderen Schadstoffen derart verunreinigt wurde, dass die Pumpwerke und Aufbereitungsanlagen außer Betrieb genommen werden mussten. Mehrere Gemeinden mussten über Tage mit Trinkwasser aus Tankwagen versorgt werden. Als Konsequenz aus diesem Vorfall erwuchs der Beschluss der zuständigen Behörden, ein redundantes System zu schaffen, welches die Versorgungssicherheit im Kanton Basel-Landschaft dramatisch erhöht: Eine 2,5 km lange „Transitleitung Birs“ aus duktilen Gussrohren DN 500 mit Zementmörtel-Umhüllung und eine neue Pumpstation sichern nun die Trinkwasserversorgung der Gemeinden im Birstal.

Spektakuläre Rohrmontage in der Vertikalen

Marco Nussbaumer

Der alpine Raum birgt nach wie vor ein enormes Potenzial zur Erzeugung erneuerbarer Energien durch Kleinwasserkraftwerke. Deren Turbinenleitungen haben sich zum typischen Anwendungsbereich duktiler Guss-Rohrsysteme entwickelt, da sie unter den herrschenden Randbedingungen den idealen Rohrwerkstoff mit der optimalen Verbindungstechnik vereinigen. Die Trassen mit extremen Steigungen liegen häufig im fast unzugänglichen Fels, und mit zunehmenden Höhendifferenzen wächst die erzeugte Leistung; der Einbau in den Steilwänden mit Hilfe von Helikoptern ist gängige Praxis. Der äußere Schutz der Rohre mit Zementmörtel lässt die

development, now offers a pipe with optimum protection. The advantage of the so-called “ZMU-Austria” coating will be seen not only in urban drinking water networks, where mechanical resistance accounts for a considerably longer useful life as compared with plastic pipes. Also in alpine areas with pipelines for hydroelectric power stations and snow-making equipment, the ductile iron pipe with “ZMU-Austria” coating is unbeatable: when it comes to sustainable efficiency, there is no need for special logistics for the bedding material as the stony trench excavation material can simply be reused without complication. And the increasing importance of the trenchless technology for laying pipes plays right into the hands of the new product.

A new transit pipeline for the Birs Valley

Marco Nussbaumer

In supposedly secure supply networks, weather events caused by climate change can cause weak spots which need to be dealt with. This is also the case in the landscape of the Canton of Basel where, in Summer 2007, torrential rainfall in the catchment area of the River Birs flooded numerous locations and polluted the groundwater by releasing fuel oil and other harmful substances, to such an extent that the pumping stations and treatment plants had to be taken out of operation. It was necessary for many communities to be supplied with drinking water from tankers. As a consequence of this incident, a decision was made by the relevant authorities to create a redundant system, which dramatically increased security of supply in the Canton of Basel: a 2.5 km long “Birs transit pipeline” consisting of DN 500 ductile iron pipes with cement mortar coating and a new pumping station now mean that the drinking water supply is secure for the residents of the Birs Valley in the Jura Mountains.

Spectacular pipe mounting in the vertical

Marco Nussbaumer

Now as ever, the alpine environment contains an enormous potential for the production of renewable energy by means of small hydropower plants. Their penstocks have evolved into the typical area of application of ductile iron pipe systems as, under the prevailing conditions locally, this combines the ideal pipe material with the optimum connection technology. Sections with extreme inclines often lie within almost inaccessible rocky areas and the energy generated increases as the height differences become greater; installation in steep rockfaces with the help of helicopters is common practice. External protection of the pipes with cement mortar allows the chunky bedding

Wiederverwendung des stückigen Bettungsmaterials zu; der Antransport von Bettungssand wäre ohnehin technisch und wirtschaftlich unmöglich. So ist das duktile Gussrohr zu einem Sinnbild nachhaltiger Energieerzeugung – nun auch in Finhaut – geworden.

Umsetzung des Schwammstadt-Prinzips

Christoph Bennerscheidt

Der Klimawandel ist unweigerlich angekommen: die beiden letzten Sommer 2018 und 2019 waren gekennzeichnet durch neue Rekorde hinsichtlich Temperatur, Trockenheit und Sonnenscheindauer. Und dies nicht nur in Deutschland, sondern auch in vielen Ländern Westeuropas. Gelitten haben nicht nur die Bäume in den Wäldern, gelitten haben vor allem die Stadtbäume mit ihrer wichtigen Funktion der Beeinflussung des Mikroklimas in der Stadt.

Unter diesen Umständen ist es überlebensnotwendig, den städtischen Bäumen bereits bei ihrer Pflanzung den für ein erfolgreiches Wachstum erforderlichen Wurzelraum zu geben und sie nicht in minimierten Pflanzgruben zu einem lebenslangen Siechtum einzusperren. Der unterirdische Raum in den Straßen ist dicht belegt mit Leitungen, Kanälen, Schächten und anderen Bauwerken. Für das Wurzelwerk eines Baumes bleibt da oft viel zu wenig Platz, als dass er sich zu einem stattlichen Exemplar entwickeln kann. Außerdem gelangt das Wasser nur in unzureichendem Maße dorthin, weil die Flächen darüber dicht versiegelt sind. Oftmals wird es sogar über Regenwasserkanäle vom Geschehen weggeführt. Dabei gibt es ein einfaches Prinzip: Rohrleitungen mit wurzelfesten Verbindungen und robustem Außenschutz werden in grobes Substrat gebettet. Damit bekommen die Straßenbäume einen gut durchlüfteten Pflanzgrund, in den das Regenwasser von den versiegelten Flächen eingeleitet und gespeichert wird. Die Bäume haben ausreichend Raum für ihr Wurzelwachstum, sie können das zwischengespeicherte Wasser aufnehmen, über ihre Kronen verdunsten und so die aufgeheizten Städte kühlen. Leitungen aus robusten duktilen Gussrohren mit wurzelfester Verbindung sind ideale Voraussetzung zur Verwirklichung des so genannten Schwammstadt-Prinzips.

Duktiles Gussrohr als Problemlöser

Gennady Walder

Ein mit zwei Francis-Turbinen ausgestattetes Flusskraftwerk in Albanien soll zur Deckung des steigenden Strombedarfs beitragen. Im Staudamm des Flusses Devoll wird eine dritte Turbine untergebracht und über eine 354 m lange Turbinenleitung DN 800 betrieben, deren Unterwasser für die Trinkwasserversorgung

material to be reused; transporting bedding sand to the site would otherwise be technically and economically impossible. So the ductile iron pipe has become a symbol of sustainable energy production – and now also in Finhaut.

Implementing the sponge city principle

Christoph Bennerscheidt

Climate change has unavoidably arrived: the last two Summers of 2018 and 2019 were characterised by new records as regards temperature, dryness and hours of sunshine. And this was not merely in Germany but also in many countries of West Europe. It is not only the trees in the forests which have suffered; trees in our towns and cities, with their important function of influencing the urban microclimate, have suffered above all.

Under these circumstances it is vital that urban trees are given the root space necessary for successful growth right from the point of planting and are not imprisoned in reduced tree pits with the lifelong decline which this involves. The underground space beneath our roads is crowded with pipelines, sewers, shafts and other structures. There often remains much too little space there for the roots of a tree to be able to develop into a splendid specimen. Also, water can only penetrate to an insufficient extent because the surfaces above are tightly sealed. In fact, it often happens that water is routed away from the tree via rainwater drainage gutters. There is a simple principle which applies here: pipelines with root-resistant connections and robust external protection are embedded in the coarse substrate. In this way the street trees benefit from a well aerated planting location in which the rainwater is routed from the sealed surface and stored. The trees have enough space for their root growth, they can take up the water temporarily stored there and evaporate it through their crowns, thereby cooling the heated cities. Pipelines in robust ductile cast iron pipes with root-resistant connections produce the ideal condition for realising the so-called sponge city principle.

Ductile cast iron pipe as a problem solver

Gennady Walder

A hydraulic power station equipped with two Francis turbines in Albania will contribute to covering the increasing electricity demand. A third turbine is housed in the barrage of the River Devoll and operates via a 354 m long penstock DN 800, the lower waters of which are treated for the supply of drinking

aufbereitet wird. Der Einbau in dem engen Leitungstunnel am Fuß des Staudammes, der Betriebsdruck PFA = 25 bar und die Längskraftsicherung der Rohrverbindungen mit dem erprobten BLS®-System, sind mit duktilen Gussrohren leicht lösbare Aufgaben.

Anergienetze mit duktilen Gussrohren

Roger Saner

Mit der im Wasser der großen Schweizer Binnenseen gespeicherten Energie steht für die Anliegergemeinden ein beträchtliches Energiepotenzial zur Verfügung. Mit Hilfe von Wärmepumpen kann es nutzbar gemacht werden. Die zum Transport des Seewassers installierten Leitungen bestehen aus duktilen Guss-Rohrsystemen, die sich dafür optimal eignen: Sie sind innen und außen gegen Korrosion geschützt, ihr großer hydraulischer Querschnitt bei gleichzeitig geringer Wandrauheit hat niedrige Betriebskosten zur Folge. Außerdem schlägt die Verbesserung des Wirkungsgrades von Wärmepumpen und Wärmetauschern positiv zu Buche. Duktile Gussrohre sind leicht und sicher zu montieren, kurzum: das duktile Guss-Rohrsystem bietet die besten Voraussetzungen zum Transport von Niedrig-Temperatur-Fernwärme.

Neue Generation weichdichtender Schieber

Matthias Müller

Die Durchdringung des Marktes mit PE-Rohren hat auch eine Änderung in der Konstruktion der Armaturen zur Folge: der bisher übliche Anschluss mit Flanschen verliert an Bedeutung; bei der Montage deutlich einfacher zu handhaben ist eine Armatur, die werksseitig bereits mit einem kurzen PE-Rohr ausgerüstet ist, welches in die Rohrleitung eingeschweißt werden kann. Der problematische Übergang zwischen Metall und Kunststoff wird damit von der Baustelle in die qualitätskontrollierte Fertigung des Armaturenherstellers verlegt.

Gemeinsam in die Zukunft

Interview mit Stefan Neuhorn

Das Schweizer Unternehmen vonRoll hydro ag hat in den letzten Jahren seine Kompetenzen in Deutschland gebündelt und neu strukturiert. Zum 1. Januar 2020 rücken die deutschen Teilbereiche nun noch enger zusammen. Die drei Vertriebsgesellschaften VONROLL, DUKTUS und KEULAHÜTTE werden in der vonRoll hydro (deutschland) gmbh & co. kg zusammengeführt. In einem Interview erläutert Dipl.-Ing. Stefan Neuhorn, Geschäftsführer der vonRoll hydro (deutschland) gmbh & co. kg, was durch diese Maßnahmen zukünftig anders und besser werden wird.

water. The installation in the narrow supply tunnel at the foot of the barrage, the operating pressure PFA of 25 bar and the restrained connections using the tried and tested BLS® system are simple tasks to solve with ductile iron pipes.

Energy networks with ductile iron pipes

Roger Saner

With the energy stored in the waters of the huge Swiss lakes there is considerable energy potential available for the neighbouring communities. This can be rendered usable with the help of heat pumps. The pipelines installed for transporting the lake water consist of ductile iron pipe systems, which are best suited for this purpose: they are protected inside and out against corrosion and their large hydraulic cross-section combined with a low pipe wall roughness results in low operating costs. In addition, improvements in the efficiency of heat pumps and heat exchangers has a positive effect. Ductile iron pipes are easy and secure to install, in short: the ductile iron pipe system offers the best conditions for the transport of low-temperature district heating.

New generation of soft-seated gate valves

Matthias Müller

The market penetration of PE pipes has also resulted in a change in the construction of fittings: flange connections, which were formerly standard, are losing their significance; a fitting which has already been equipped in-works with a short PE-pipe which can be welded into the pipeline is considerably easier to handle during installation. The problematic transition between metal and plastic therefore shifts from the construction site to the quality-controlled production by the manufacturer of the fitting.

Together in the future

Interview with Stefan Neuhorn

In recent years the Swiss company vonRoll hydro ag has concentrated and restructured its skills in Germany. As from 1st January 2020 the German sectors are now moving even closer together. The three distribution companies VONROLL, DUKTUS and KEULAHÜTTE are being brought together as vonRoll hydro (deutschland) gmbh & co. kg. In an interview, Dipl.-Ing. Stefan Neuhorn, Managing Director of vonRoll hydro (deutschland) gmbh & co. kg explains what is going to be different and better in the future because of this measure.

Manfred Künze, Christoph Aigner and Christoph Bennerscheidt

Annual report 2019 and perspective in 2020

In the last couple of years the effects of climate change have been felt in Europe, and in Germany too, more than ever before. The long periods of high temperatures in combination with low levels of rainfall in the spring and summer of 2018 not only put a strain on us humans but the natural world visibly suffered as well. This trend continued in 2019. The year 2019 saw a new national heat record being set in Germany: from 24 to 26 July 2019 an extraordinary heatwave saw maximum temperatures of more than 40 °C on three consecutive days in the West of the country – for the first time since systematic weather records began!

Climate protection programme 2030

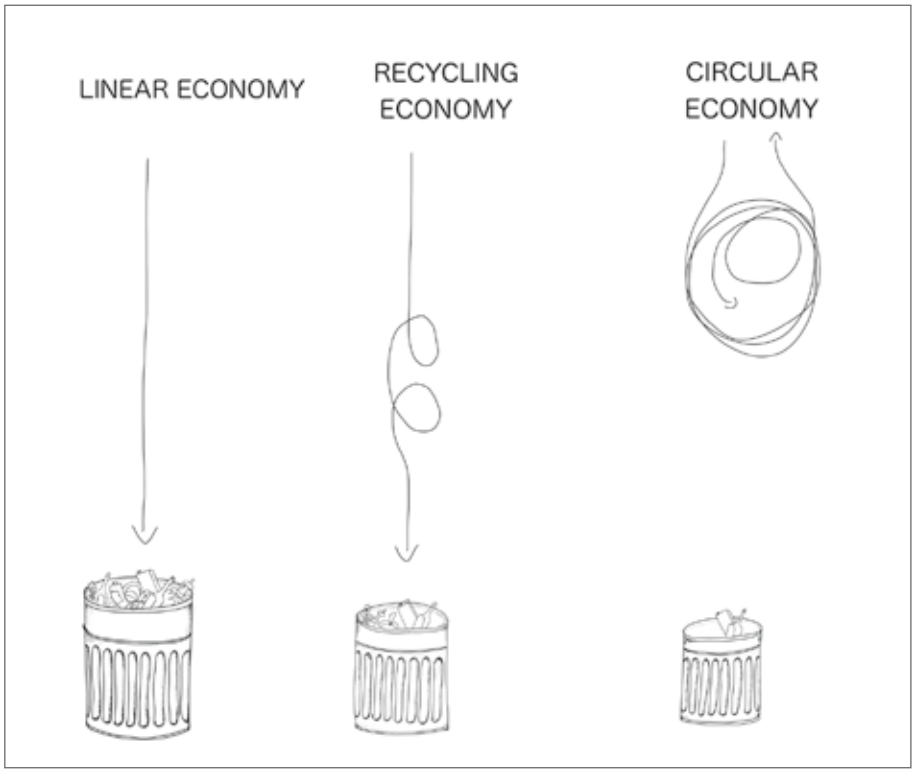
At the same time, the actions taken by the younger generation were stepped up, raising awareness of the consequences of climate change and the need to reduce CO_2 levels. Climate change became a mainstream topic and resulted in some political decisions. So, on 20 December 2019, the Climate Protection Programme 2030 put forward by the German Federal Government was also approved by, the German Bundesrat, or upper house. Thus the amended law for the implementation of the Climate Protection Programme 2030 will come into effect in tax law as planned on 1st January 2020 – once it has been signed by the German Federal President and published in the Federal Gazette [1]. As a result, as from 01.01.2020, tax will be charged on CO_2 at a rate of 25 euros per tonne. The revenue received by the State will primarily be used to ease the burden on citizens, e.g. by reducing the EEG levy.

EADIPS FGR is keeping an eye on the effects which the Climate Protection Programme 2030 will have on the German/European industrial base. So, with the introduction of the climate action programme 2030, there should not be an even greater distortion of the market worldwide.

CO_2 reduction and the recycling economy

Already, and long before the introduction of a tax on CO_2, the full members of EADIPS FGR have started to reduce their CO_2 emissions. At the same time they have increased the proportion of secondary raw materials in their production processes and, in so doing, have clearly shown that climate protection measures and the recycling economy are not mutually exclusive but must be supportive of each other. The differences between a Linear Economy, a Recycling Economy and a Circular Economy are shown in the illustration.

Cast iron as a material has a decisive advantage over other materials here. Cast iron and the products made with it for ductile cast iron pipe systems are by and large free of fossil resources. CO_2 reduction will therefore be determined by the production process and not by the material itself. Against this background, it is clear that the members of EADIPS FGR together with manufacturers of production components, such as induction or cupola furnace manufacturers oreven the producers of blasting agents should look closely at CO_2-neutral production. This happened at a joint workshop in



From the Linear Economy via the Recycling Economy to the Circular Economy.

October 2019. The initial results are described in the article by Mario Mackowiak "The Foundry Industry = Recycling Industry" [2]. However, from the considerations in [2], it is also clear that the foundry industry cannot accomplish this transformation process on its own and support from the Climate Protection Programme 2030 must urgently be sought.

At this point we would like to thank the members of EADIPS FGR for their collaboration on the committees and at the workshops:

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 & co. kg

as well as

Sponsoring members

- Akzo Nobel Powder Coatings GmbH
- Rhein-Ruhr Collin KG Geschäftsbereich HTI
- TMH Hagenbucher AG
- Stark Deutschland GmbH (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

Work on rules and regulations

As usual, EADIPS FGR and its members are supporting and organising work on the rules and regulations concerning ductile cast iron pipe systems and in doing so have an ability to think outside the box. The developments in the European drinking water guideline, supported by EADIPS FGR as a member of EDW – European Drinking Water – are exciting. In the context of the fifth trialogue on 18 December 2019, the European Council and the EU Parliament reached a preliminary agreement on the new version of the drinking

EADIPS FGR and/or its members are represented on the committees listed below and actively participated in the revision or development standards on their various subjects:

- **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 003-01:** Standards committee for industrial valves (NAA)
  - NA 003-01-16 AA: Industrial valves for water supply, diaphragm valves, check valves, hydrants, gate valves, globe valves, butterfly valves and plug valves
- **DIN NA 082:** : Standards committee for pipelines and boiler plants (NARD)
  - NA 082 BR: NARD advisory board: From the Linear Economy via the Recycling Economy to the Circular Economy
  - NA 082-00-05 AA: Mirror committee for TC 203, excluding EN 598
- **DIN NA 119:** : Standards committee for Normenausschuss Wasserwesen (NAW)
  - NA 119 BR: NAW advisory council
  - 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 (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 vice-chairmen on 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

water guideline. The provisional agreement now still has to be formally approved by the European Parliament and Council. Once approved, the guideline will be published in the Official Journal of the EU and will come into effect 20 days later. After that, the member states must implement the new provisions at national level within 2 years.

EADIPS FGR has also been following developments in the recycling economy at DIN (Deutsches Institut für Normung) with great interest and, for example, it participated in a workshop at the end of October 2019 in Brussels [3]. Also exciting at this point is the distinction between a Linear Economy, a Recycling Economy and a Circular Economy. When it comes to cast iron, the circular economy is in fact practicable for hygienically sensitive drinking water applications as it does not have any limitations as regards drinking water hygiene.

One good step forward is the development of the quality specification for the RAL quality label for ductile cast iron pipe systems – pipes, fittings and valves, which has been developed in department 8 (FB8) by GET – Gütegemeinschaft Entwässerungstechnik e. V. in cooperation with EADIPS FGR.

Perspective

Climate change and the recycling economy are the driving forces behind an altered perception of processes and technical solutions. The full members of EADIPS FGR have already taken early steps to start adapting the production processes for ductile cast iron pipes, fittings and valves in the direction of climate neutrality and the recycling economy. The Climate Programme 2030 will further accelerate this process.

But the members also have a proposed solution for measures to adapt to climate change. The application of the soil/pipe system in order to implement the sponge city principle in piping trenches will also be pushed further forward by EADIPS FGR in the coming year.

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[3] Workshop: Material value chains for circular economy in metal, wood, plastic and concrete. Brussels, 29.10.2019; https://circulareconomy.europa.eu/platform/en/news-and-events/all-events/material-value-chains-circular-economy-metal-wood-plastic-and-concrete

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NEWSLETTER

Dear Readers,

shortly before the effects of the corona virus on daily life are now becoming noticeable, the pipeline industry traditionally met at the Oldenburger Rohrleitungsforum 2020. Many thanks to the organisers of the 34 Forum: As usual, the trade exhibition, the technical presentations and the supporting programme interacted harmoniously, so that individual exchange was possible and one was informed "incidentally" about the current trends in the industry. Planning, construction and operation of ductile cast iron pipe systems were traditionally represented in a separate lecture block.

In the first article of this newsletter we take you to Mongolia as a country of extremes: climate, distances, population, topography - nothing reminds of European conditions. The population density alone is 120 times less than in Germany, the distances are gigantic. This is the field for sophisticated logistics, where the task is to build a 55 km long drinking water transport pipeline for a provincial town with 30,000 inhabitants.

However, action was also needed in the Swiss canton of Basel-Landschaft after the extreme rainfall in the Birs catchment area flooded several villages in the summer of 2007 and the groundwater became so polluted by the release of heating oil that the pumping stations and water treatment plants had to be shut down. A 2.5 km long "Birs transit pipeline" and a new pumping station now secure the drinking water supply for the communities in the Birs Valley.

Finally, read about a resilient seated gate valve which is used to transfer the problematic transition between metal and plastic from the construction site to the quality-controlled production of the valve manufacturer.

Replacement of the 120 year old grey cast iron drinking water main (Long pipe relining)

vour of the tried and tested

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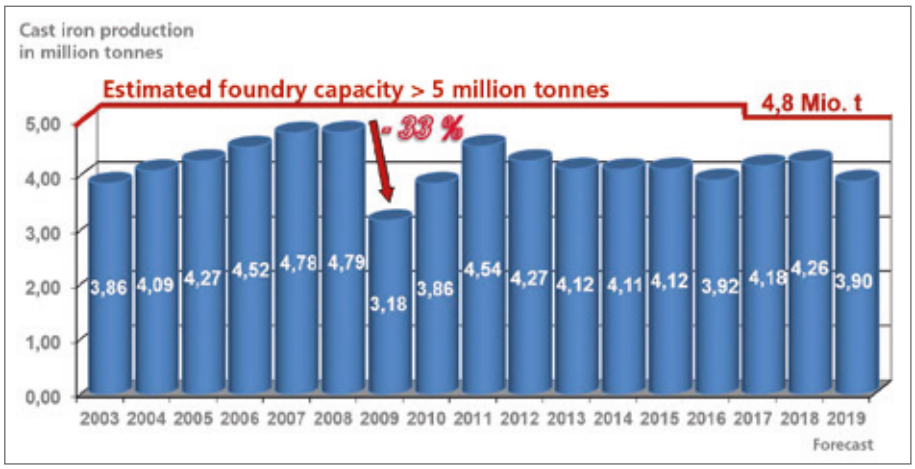
Mario Mackowiak

The Foundry Industry = Recycling Industry

Economic situation and perspectives

Indicators, structures and sales statistics for the German foundry industry were the subject of an article in Volume 53 in January 2019. In particular, the sections on "Outlook" and "Cast iron initiative" triggered an unexpectedly intensive discussion process which went considerably beyond manufacturers and customers in the cast iron pipe system sector. But first, let us have a look at the economic situation of German iron and steel foundries as a whole.



BDG (Federal association of the German foundry industry): Newsletter 09-2019, Düsseldorf

The business status of the foundry industry

For almost all indicators, business performance for the year 2019 in no way corresponds to the successful progress in 2018. By July 2019, the casting production of German iron and steel foundries had already fallen by nearly 9 %. However, progress with incoming orders was considerably more critical, being 17 % below the values for the period in the previous year. This of course meant that the cushion of orders melted away like the proverbial "butter in the sun".

When we take account of the client structure, we get the following picture as regards the production level of German iron and steel foundries [1]:

Vehicle construction:	– 18.9 %
Machine construction:	– 13.4 %
Other applications (including cast products for the building trade):	– 1.0 %
Total:	**– 8.6 %**

Unfortunately, this confirms the market forecast for 2017 already stated on page 18 of Volume 53 much more clearly than anticipated. The integration of the projected iron and steel production figures into developments since 2003 thus firmly brings the foundries firmly back down to earth.

1 million tonnes of the estimated foundry capacity of 4.8 million projected for iron and steel castings will not be needed in 2019. This amounts to a foundry utilisation rate of approx. 80 %. In the end, even at this early stage, all this points to a difficult first half-year for 2020. Because of the extraordinarily poor level of orders received during the course of 2019, from the current viewpoint this is the only prognosis which can be given for 2020.

Causes and categorisation

The causes are many and varied and they are specific to the respective client categories. Matters which affect all sectors are the international trade disputes which, above all, hinder the export-oriented vehicle and machine construction trade as well as the increasing uncertainties of the BREXIT process'. Specific factors are, for example, the E-mobility hype which, for German founders for vehicle components, means not merely an economic downturn but, by now, a structural crisis.

And, in particular, operations which have cast iron pipe systems as their key production area are suffering even more from the reprehensible economic sanctions against Russia, which is one of the most interesting future markets for water supply. By contrast, Chinese suppliers are winning Russian markets to the same extent as they are being lost by Central European manufacturers.

Finally, client sectors are having an effect on the increasing deterioration of the economic environment in Germany overall. To describe this in detail would go beyond the scope of this article, so we will only mention the increase in energy costs. It is not only the level of electricity prices in themselves, both in Europe and across the world, that is unparalleled. Much more emphasis should be placed on uncertainties

in baseload generation and in energy transmission, including the future costs associated with this which, to date, are entirely unclear but are in the focus of industrial and private consumers.

And, as is already the case in the chemical industry, foundries are also clear about the fact that the investments which will doubtless be necessary for the further reduction of greenhouse gas emissions will increase the electricity requirement, and hence electricity costs, massively [2].

To summarise, it must therefore be stated that almost all client sectors will meanwhile find themselves in situations of structural upheaval as a result of change in the widest range of sector-specific framework conditions.

For manufacturers of cast iron pipe systems, however, this situation is not entirely new. Competition as regards materials has dominated in this sector for decades, particularly focussed on cast iron versus plastics.

This debate is subject to entirely new impetuses, on the one hand because of ever-increasing knowledge about the effects of plastics on the environment and humans [3]. On the other hand, there is the fact that the foundry industry in general and the manufacturers of cast iron pipe systems in particular have long since been looking at the subject of circular economy and hence the efficient handling of resources.

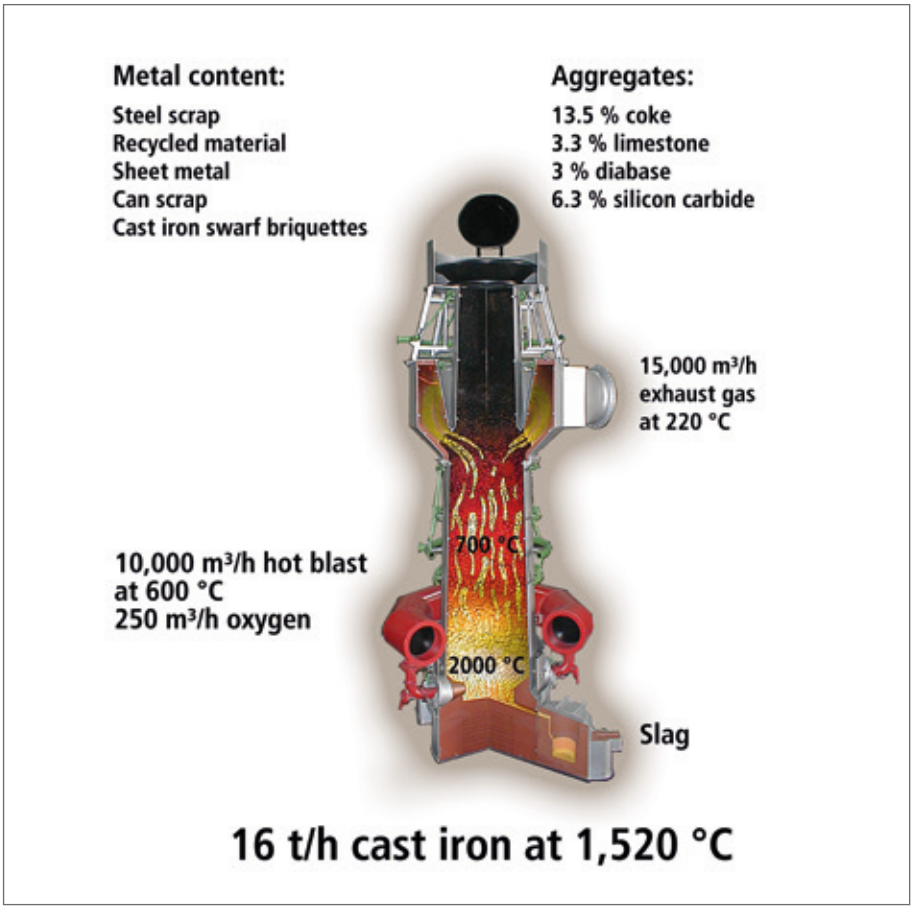
The production of cast iron pipe systems – initial situation and prospects

The changeover in the production process to the efficient handling of resources has, in the opinion of the author, been underway more emphatically than ever since the beginning of the 21st century and, despite the very considerable success achieved so far, is still a long way from being completed (if there can be said to be completion at all!). The three significant examples below give a striking illustration of the level of work achieved and the tasks yet to be completed.

Firstly, the melting process
For the last time, the July 2011 issue of the "Ductile iron pipe systems" handbook contained its own section on the blast furnace process on page 3/2. According to this, iron for the production of pipes and fittings can be produced either as pig iron from the first melting or as a recycling material from steel scrap, cast iron scrap and foundry pig iron. That was the text at the time, supplemented by the illustration of a blast furnace tapping [4].

The so-called liquid compound process as the direct charging of molten pig iron from the blast furnace into the channel-type induction furnaces downstream in pipe foundries was, for decades, the characteristic method of producing cast iron pipes and, in some cases, cast iron fittings as well. Molten pig iron and ultimately the pipe bodies were produced almost exclusively by reducing the limited resource of iron ore available worldwide with the help of coke and limestone in the blast furnace process.

The fundamental change was documented in the October 2015 issue of the same handbook in the introductory sentence on page 3/4. Usually, foundries now melt their iron in cupola or electric furnaces from recycling material and pig iron [5]. Particularly with the cupola furnace process, up to 100 % scrap with differing classifications is used today. In turn, the cast pipe bodies are accordingly produced exclusively from recycled materials. The melting of iron ore has been completely dispensed with.



Cross-section of a cupola furnace and its operation.

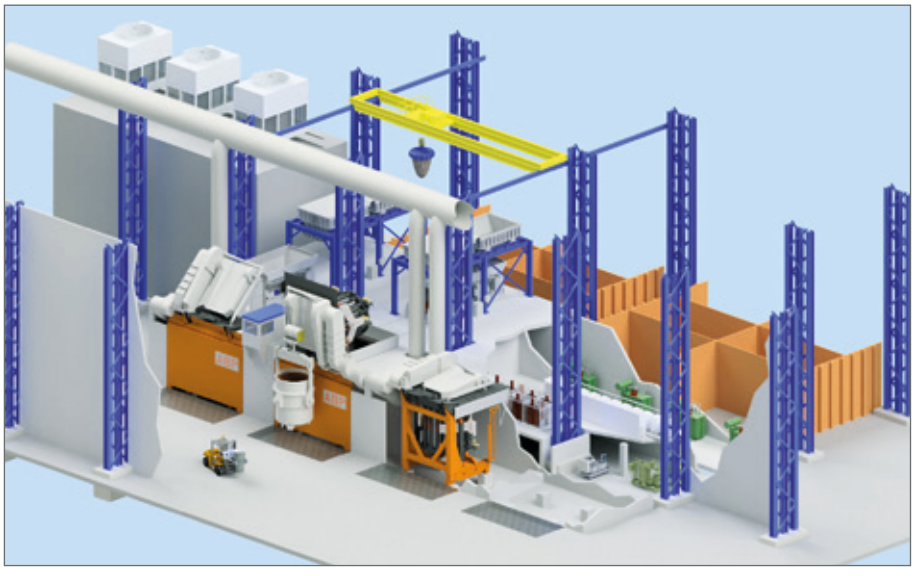
So far, so good – if it was not for the increasing CO_2 debate. Taking account of the fact that the burning of one kilogramme of carbon releases 1.87 m³ CO_2 and our coke contains around 91 % carbon, this results in 1.7 m³ or 3.36 kg CO_2 being released in the burning of one kilogramme of melting coke. The assumption that, with a 130 kg volume of coke used, the CO_2 emission is 437 kg per tonne of molten iron is not correct. With the cupola furnace method and as a result of some very complex reactions, a major part of the carbon contained in the coke concentrates the C-content of the molten mass to the desired value. Regardless of this, however, CO_2 occurs depending on the type of construction and operation of the cupola furnace melting plant.

Accordingly, the ostensible objective of this melting process is the achievement of a more efficient combustion. A special process of oxygen injection will significantly reduce the consumption of melting coke in the future and so result in a considerably lower CO_2 emission.

A smelter which is increasingly being used in iron foundries is the crucible induction furnace. The diagram in the illustration shows the basic structure of an electric melting operation with three ABP type crucible induction furnaces [6].

The cylindrical vessels with fireproof cladding are surrounded by coils through which an alternating current flows, thereby inducing a secondary current in the metallic insert. Under ideal molten iron production conditions, there is an energy consumption of 580 to 600 kWh per tonne of molten iron at approx. 1,480 °C tapping temperature. If the current needed for melting is taken from renewable energy sources, the result actually represents an excellent environmental balance and energy resource efficiency. The original limit of an average 18,000 t cast iron production and 27,000 t to 30,000 t molten iron which applied to medium-sized foundries is also history. ABP Dortmund meanwhile is building melting plants worldwide for more than 80,000 t molten iron.

Of course, there is also some homework to be done by electric melting operations, even though it differs from what is needed for cupola furnaces. The metallic insert for crucible induction furnaces not only contains steel scrap but, due to the absence of a carbon carrier and the altered nucleation state, it requires a certain proportion of pig iron. It fluctuates practically between 5 % and 30 % in the cold state, depending on the structure of the casting, the cast iron production process and the quality of the casting itself.



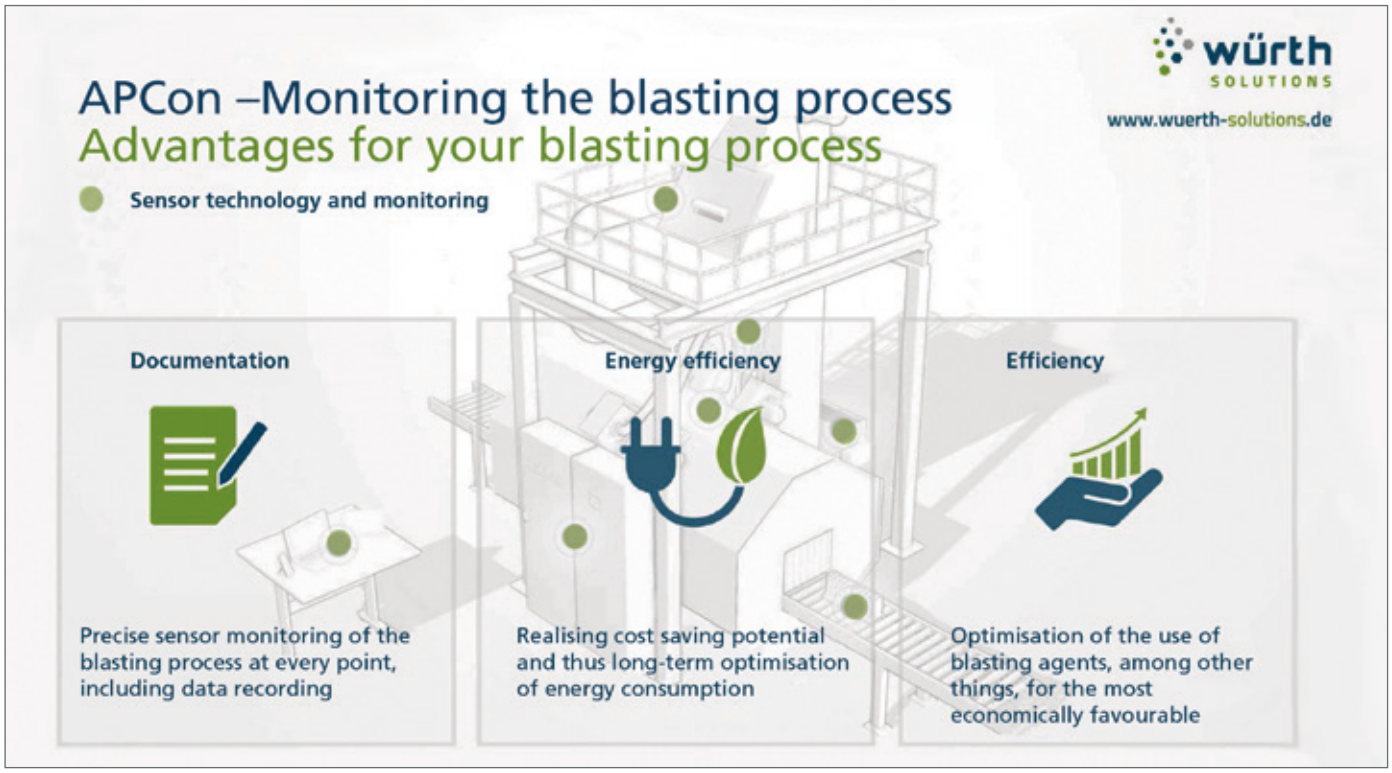
Electric furnace operation with three crucible induction furnaces.

To summarise, according to current levels of knowledge, it remains to be said that a further reduction of pig iron proportions in the charge for crucible induction furnaces seems realistic as compared with a considerable reduction of the CO_2 emission of cupola furnaces. It can be inferred from this that, at the moment and from environmental view-points, an electric melting operation with mid-frequency crucible induction furnaces represents an interesting alternative, even for pipe foundries.

Secondly, the blasting process

The blasting process in foundries producing fittings and valves is rather unprepossessing and therefore often treated with disrespect. In so far as the foundries operate coating systems downstream of the main process, the blasting of unfinished castings commonly used in foundries to remove adhering sand and core residues is supplemented by a special surface treatment blasting process. The aim is to achieve the greatest possible degree of cleanness, also referred to as the surface preparation grade, of at least Sa 2 1/2, directly before the coating process. As a rule, the blasting machines contain round-grain cast steel blasting abrasive with a grain size of 1.0 mm to 1.6 mm. Special blasting processes require a proportional admixture of angular blasting agent.

Something which is less well known and therefore neglected is the high energy consumption due to uncontrolled blasting machine operation. The leading blasting agent manufacturer, Würth in Bad Friedrichshall, has now taken up this problem, regardless of type, and



Monitoring the blasting process.

for some time has been applying itself to corresponding energy efficiency programmes. The status of the work to date is shown in the "Blasting process monitoring" illustration [7].

Targeted sensor monitoring and simultaneous data recording of the widest range of blasting machine functions produces the highest possible level of process transparency. With the AP-Con – Abrasive Process Control project, energy savings potentials of > 20 % become accessible.

Thirdly, the regeneration process for mixed used sand bonded with bentonite

Foundrymen initially distinguish two basic possibilities as regards the moulding process:

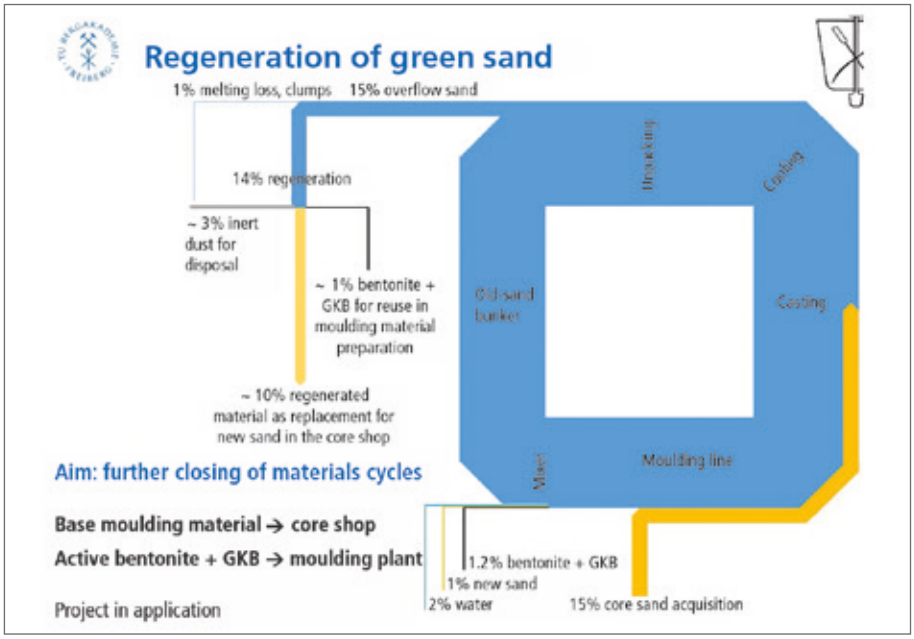
- permanent moulds, e.g. for the production of cast iron pipes in the centrifugal casting process with the help of metallic moulds and
- lost moulds, i.e. processes with single-use moulds.

Fittings as well as castings for hydrants and valves are almost exclusively produced with lost moulds and corresponding cores to form hollow spaces and/or contours. While castings for cast iron pipe systems of larger nominal sizes are hand-moulded in chemically bonded moulding materials, the production of smaller nominal sizes, as a rule up to DN 400, is done on moulding lines with bentonite-bonded green sand in the sand circuit. In particular because of the inflow of core sand, represented by the yellow line in the illustration, there is an accrual of overflow sand [8]. This mixture of bentonite-bonded moulding material and core residues, sometimes in fact from different types of core production processes, is referred to as mixed used sand or used foundry sand.

The regeneration of mixed used sand with the aim of reusing the quartz sand in the core shop, while at the same time reusing the bentonite and carbon components which get into the sand circuit, is proving not too feasible at the moment because of the absence of complex regeneration processes. The volumes of used sand produced annually are not inconsiderable. The Saxony iron and steel foundries alone dump around 220,000 t each year for a cast iron production of about 320,000 t.

The accrual of used foundry sand in the production of fittings as well as cast parts for hydrants and valves is particularly high. As a rule, low cast iron wall thicknesses surround large-volume cores and, depending on the configuration and the process, result in poor casting/sand ratios. Regardless of the critical materials balance itself, from the ever scarcer landfill space in Germany, it is clear that there is a further and dramatically increasing pressure to close the foundry sand circle.

But action will also be taken here. In consultation with the most seriously affected Saxony iron and steel foundries as well as the eastern region sector of the German foundry industry federation, the Gießerei Institut and the Institut



Summary representation of sand circulation in a moulding line.

für Aufbereitungsmaschinen at the Technischen Universität Bergakademie Freiberg have started on an R&D-project. The scientific challenge of the project consists of developing an appropriate recycling technology for overflow sand with fluctuating proportions of core sand, an holistic consideration of the technology and economics involved in regenerating the overflow sand and the reuse of the regenerate quartz sand produced, including the components produced which contain bentonite and carbon, with records of the energy consumed in the individual processes. The start is scheduled for the first quarter of 2020.

Summary

Today, manufacturers of cast iron pipe systems have already made enormous progress in reducing the CO_2 emissions in their melting processes and closing material cycles.

On the basis of three examples it has been strikingly shown that these processes are far from being complete but that promising solutions are to be expected from the sector in the coming decade. All of the steps introduced for the reduction of CO_2 emissions as well as for closing material cycles are aimed at proving that the European producers of ductile iron pipe systems who are united under the EADIPS FGR banner are global role models in the handling of resources and providing entirely new decision-making standards for the choice of pipe systems for network operators and other users.

Thanks

Warm thanks go to the companies supporting the "Cast-Iron Initiative", in particular to Dr Marco Rische from ABP INDUCTION, Dortmund, and to Joachim Vianden and Timo Winkler from Eisenwerke Würth, Bad Friedrichshall.

Finally, I should also express thanks for the constructive collaboration of the Foundry Institute at TU Bergakademie Freiberg, represented by Prof. Dr Gotthard Wolf and Dr Marco Weider.

Keywords

Foundry industry, iron foundries, steel foundries, "cast iron initiative", recycling, crucible induction furnaces, resource efficiency, foundry sand circulation, circular economy

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Patricia Pfister

55 km drinking water pipeline over 550 m altitude

Along a route in Mongolia presenting some extreme challenges

Extreme temperatures, challenging gradients and transport logistics which, because of the remoteness of the site, presented some serious snags: all this was expected by cast iron pipe manufacturers Tiroler Rohre (TRM) in Mongolia who are providing a drinking water supply for the city of Altai with its 30,000 inhabitants. This will run through a 55 km long drinking water pipeline which has to overcome an altitude of 500 m. The conditions place high demands not only on the project management team but also and in particular on the logistics, the installation and the piping material itself. Finally, in places the cast iron pipes must withstand pressures of 50 bars as well as seismic activity.

In geographical terms about four and a half times the size of Germany, with around 3 million inhabitants, Mongolia is the least densely populated country in the world. Just about half of the population is concentrated in the capital city of Ulaanbaatar, while the rest of the country is characterised by the vastness of the landscape. But even its bareness is surpassed by the extreme weather conditions: its location in the central Asiatic uplands means that in winter the country experiences daytime temperatures of –40 °C and in summer of +30 °C; the fluctuations are two to three times greater than in Western Europe. So, it is easy to guess how tight the time window is for major infrastructure projects. But, with some sophisticated planning, even this challenge can be overcome as is being proved by the latest international project of the Tiroler Rohre GmbH company, based in Hall in the Tyrol. This cast iron pipe manufacturer is currently constructing an approximately 55 km long drinking water pipeline from a reservoir lake which will supply the provincial capital of Altai. *"We are supplying and laying the pipes as well as the water purification system and pumping stations"*, explains Andreas Weiler, the International Sales Director for TRM who is in charge of the project.

Transport presents the greatest challenge

In many Central Asian areas, water is a rare commodity. And Mongolia too faces enormous challenges when it comes to securing its fresh water resources. Therefore, for supplying drinking water to the 30,000 inhabitants of the city of Altai they need experienced specialists for geologically demanding construction sites and the appropriate extremely robust material.

They found what they were looking for in the experts from TRM who started planning the project in the late summer of last year. As the prime contractor, TRM has overall responsibility for delivering all the materials, such as ductile cast iron pipes in nominal size DN 250 for example, and also for planning, executing and supervising the construction work. By bringing in the ÖSTAP Engineering & Consulting company from Vienna for the planning work and for project oversight and assistance, an experienced partner was able to be gained.

By far the greatest hurdle when constructing the drinking water pipeline is logistics: transporting materials from the factory in the Tyrol to the construction site, in some cases across unsurfaced roads, represents a considerable effort and expense for the transporter. For this, the Spedition Strieder company with its many years of experience in transporting ductile iron pipes was able to offer the best solution: the pipes travel by rail to the Mongolian capital of Ulaanbaatar, from where they are taken by road – in some cases dirt roads – on to the construction site. Andreas Weiler has accompanied the transport part of the way which, in total, amounts to just about 1,000 km. *"Apart from the journey by Trans-Siberian Rail, I've done the lot"*, says the Project Director with a smile.

Temperatures as low as –40 °C, which prevail in the Mongolian winter and cause the ground to freeze to a depth of up to 3.5 m, make it necessary to lay the pipes 4 m deep.

The construction site in Altai is approx. 1,000 km or more than 14 hours' drive from the Mongolian capital of Ulaanbaatar. Mongolia is four and a half times bigger than Germany with only around 3 million inhabitants. This makes it the least densely populated country on Earth.

Cast iron pipes must withstand earthquakes

The water for the drinking water supply will be taken from the reservoir near the village of Taishir, then it will be treated and pumped 500 m upwards to the city of Altai at an altitude of 2,200 m. The material requirements for this are enormous. Because of the major height difference, the pressure in the pipeline increases to more than 50 bars in places. *"This high pressure can easily be absorbed with cast iron pipes, but with other materials one would have to incorporate pressure reduction stages"*, explains Andreas Weiler. The fact that these requirements are not met by just any material has been confirmed in a preliminary study – the cast iron pipe proved to be the best solution. Mongolia lies in a highly seismically active area where earthquakes are a frequent occurrence. Therefore, it is extremely important that the joints of the cast iron pipes can absorb tremors and earth movements.

In the vast open spaces of the rocky West Mongolian desert: the transport pipeline extends over 55 km from the reservoir close to the village of Taishir to Altai.

A tight time window for the construction work

One can see how the height difference represents a major challenge, but the extreme climate has a part to play as well. If a certain amount of preliminary work could still be completed in autumn 2018, the watchword soon became: wait. Because winter in Mongolia lasts a long time. Until the month of July, ground frost is a factor to be reckoned with – at least at night – throughout the year. The time framework for the construction work is accordingly cut very narrow and only leaves room for manoeuvre from May to October. Temperatures as low as –40 °C,

Mongolia lies in a highly seismically active area where earthquakes are a frequent occurrence. Therefore, it is extremely important that the joints of the cast iron pipes can absorb tremors and earth movements.

By far the greatest hurdle when constructing the drinking water pipeline is logistics: transport from the factory in Hall in the Tyrol to the construction site, in some cases across unsurfaced roads, represents a considerable effort and expense for the transport company.

which cause the ground to freeze to a depth of 3.5 m, make it necessary to lay the pipes 4 m deep. Also, the depth to which the reservoir freezes is greater than one would expect in Central Europe: water extraction is done at a depth of 14 m.

The weather does not only hold extreme temperatures in store, sandstorms also make the construction work more difficult. *"When we are actually assembling the pipes, it is important that everything is as clean as possible so that the seal sits in the right position. If the sockets are totally dirty and full of sand, then they have to be cleaned"*, says the Project Director, thinking of the additional time and effort expended because of the Mongolian weather phenomena.

Completion is in sight

Currently the construction work is fully underway and should be completed in the middle of next year, thus ensuring the supply of clean drinking water for around 30,000 people. At the moment the population is being supplied with water of uncertain quality from deep wells. The entire project, with a contract value of 14 million euros, is financed by an Austrian development aid loan.

Keywords

Mongolia, Altai, drinking water pipeline, extreme weather conditions, earthquake zone, DN 250 cast iron pipes

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Lutz Rau and Jens Große

Large-dimension interim pipeline for the inner city

A cast-iron solution

Interim pipelines are no makeshift measure

Positive locking and flexible thrust-resistant systems have extended the range of application of ductile cast iron systems. These thrust-resistant systems have shown that they can withstand all loads produced by internal and external forces. In the construction and during the operation of pipelines with restrained joints in tunnels and under bridges, when used with the application of trenchless installation techniques and when laying in open trenches, the planning engineer is working in the realm of generally accepted codes of practice.

Interim pipelines are also constructed using thrust-resistant ductile iron pipes. They are not makeshift measures but offer transitional or workaround solutions for an urgent engineering problem: by using them, supply or disposal can be ensured over limited periods while sections of pipeline are being repaired or newly constructed. Generally speaking, interim solutions have to secure problem-free continued operation even under changing operating conditions. EN 805, 5.4 applies here: protection of the system: "buried systems are generally secure, sections of pipeline above ground however need to have particular attention paid to them" [1].

The construction and operation of interim pipelines have sufficiently proved themselves in practice and have been described in a number of EADIPS FGR annual reports and elsewhere [2], [3], [4]. All of these projects were planned individually and were achieved successfully and to the satisfaction of the clients. Therefore, it can be justifiably claimed that this represents the state of the art.

Building on this, right now Berliner Wasserbetriebe is preparing the draft of a works standard so that interim pipelines will soon be able to be planned and constructed according to generally accepted codes of practice.

Big sizes – big challenges

In its investment planning up to the year 2023, Berliner Wasserbetriebe is directing its main focus on sewage disposal and, in this sector, especially on the replacement of pressure pipelines, which will be reflected in very high investment costs. In inner-city areas, large-dimension pipelines in particular mean that all those involved (planning and execution) are faced with big challenges if disruptions are to be kept as low as possible. In addition to new constructions with steel and cast iron pipes, renovation procedures will also be used. The choice of material and construction process and coordination with all relevant legal entities is a prerequisite for a successful construction project, carried out by experienced and certified construction companies with the corresponding knowhow. In addition to implementation according to engineering standards, the chosen construction project must also represent the best option from the point of view of costs.

Practical example of a construction project: Hermann-Hesse-Straße

In the Berlin district of Pankow, in Hermann-Hesse-Straße, an old DN 1200 grey cast iron pipeline was to be replaced along the same route by new ductile cast iron pipes of the same nominal size.

Construction site sign on Hermann-Hesse-Straße in Berlin Pankow.

To do this, it was necessary to set up a 378 m long emergency or interim pipeline with ductile iron pipes above ground along the central reservation (parking strip) between the traffic lanes of Hermann-Hesse-Straße. To achieve this, clearance had to be secured for execution with at least one side of the street being able to take traffic (one-way traffic regulation).

In addition, in this area the measures taken had to consider the interests of a hotel, a children's nursery and a school. This meant that the school bus and delivery vehicles had to have access to certain areas of the closed carriageway for short periods and a corresponding stopping point had to

be set up for the bus. The interim route also had to be culverted to make it possible to drive over it.

Also, the residential area, nursery, hotel and school should not have to put up with any bad odours. Therefore, it was decided to have manually operated vent valves installed at the high points. As the construction work was carried out in winter, it was also necessary to have any temperature-related linear expansion checked, although because of the constant throughput of the medium, a relatively low temperature fluctuation was to be assumed.

Despite the stable and robust pipe material and the thrust protection, a pipeline laid above ground along with its components must present a high level of security against external mechanical stresses (vehicle accidents, vandalism, fire control or falling trees and branches) and guarantee safe operation. A careful risk analysis had to be carried out.

Cast iron pipe systems meet all requirements

For the construction of the new sewage pressure pipeline, it was planned to use DN 1200 thrust-resistant cast iron pipes. For the interim pipeline, DN 1000 thrust-resistant cast iron pipes to EN 598 with BLS® push-in joints for easy assembly and dismantling were selected. Being a temporary measure, this reduction in dimension was justifiable.

The ductile material of the pipe is impermeable and it is sufficient to provide a bracket or the corresponding saddle as a support every 6 m in the socket area.

For cast iron pipelines laid above ground it is obligatory to use a positive locking thrust protection system as friction-type thrust protection systems, such as TYTON SIT PLUS®, only offer the corresponding guarantees for installation underground. Regardless of the length of the section of pipeline, it is also basically necessary that each push-in joint is resistant to tensile forces.

It was precisely the ease of handling, secure operation and ease of assembly and dismantling which were decisive as regards the use of ductile cast iron pipe systems. Their 6 m length makes the pipes easy to transport and install.

It is clear that, as compared with welded steel pipelines, installation using the push-in joint saves a considerable amount of time, in contrast to welds and the subsequent corrosion protection which they need. Separating welded steel pipelines when dismantling them afterwards also takes time and is associated with real nuisance factors (noise, dust, smell) for the surrounding area. The dismantled pipes can be used again multiple times without problem. The cast iron pipes are robust and joined together every 6 m by the flexible restrained joints.

For changes of direction in the area of the route and for the culverts (making it possible to drive over the pipeline) the client decided to opt for welded steel pipe sections which have been joined to the pipeline using fittings (flanged spigots and flanged sockets) from the full BLS® range.

Completion made to measure

The pipes were delivered, in order, on open trucks to make it easier to unload them and the accessories needed (BLS® segments, NBR seals, fixing brackets, lubricant, assembling tools etc.) for the whole of the construction section were sent separately in pallet cages.

Surfaces and utility lines in adjacent sites were also protected with steel sheet.

Hardwood cradles were used to support the interim pipeline. The upper part was designed as a saddle with a steel sheet strip inserted in it as a kind of bearing so that, in case of any longitudinal expansion, the saddle could not tip over. Beneath the wooden elements, a

Flanged spigot assembled in the pipe socket using the BLS® system.

A view along the construction site.

Pipe string with supports and steel plates laid out.

Hardwood supports with sliding plate and load distribution plate.

Assembled BLS® joint with pipe supports.

Stretching the BLS® joint.

square, 1 cm thick steel plate was applied to the subgrade to distribute the load.

The pipeline was installed along precisely straight lines, both horizontally and vertically. The weight of a DN 1000 pipe when completely full is 4.7 tonnes with a permissible tractive force for the BLS® push-in joint of 1,560 kN. In order to allow for slight movements, the pipes were not fastened separately or fixed by other means.

The pipes were then assembled according to the manufacturer's specifications by means of chain hoists, with the BLS® segments in the crown of the pipe being plugged into the windows of the socket face, distributed around the circumference and then moved along. The position of the BLS® segments is additionally secured using fixing brackets supplied to the site.

After assembly, the joint has to be stretched by jacking (or with a hydraulic ram) between the socket face and the bracket of the assembling tool so as to reduce possible subsequent longitudinal expansion to a minimum, but also to exclude any excess stretching of the pipe string during pressure testing.

Then, a further buffer device consisting of reinforced concrete elements was applied to give the pipeline additional protection against any road traffic accidents. The individual reinforced concrete elements were interlinked and roughly stamped with concrete. This additional protection measure was necessary as the speed limit of 30 km/h is not always observed.

Once the pipes had been assembled, the sections of pipeline underwent pressure tests using fittings, which were the same as the fittings required for assembly. Tightness testing of pressure pipelines laid above ground has two purposes:

- the final stretching of the restrained joints,
- at the same time, to provide evidence of the integrity and tightness of the pipeline.

Because the pipeline is laid above ground, the highest safety levels must be guaranteed for construction personnel and the surrounding environment. The later operating conditions will be below these pressure test parameters and are thus secured.

There were no disruptions or surprises at all while it was in operation.

Once the replacement DN 1200 pressure pipeline was commissioned, the interim pipeline was able to be dismantled and taken away. Dismantling it was really simple:

- Releasing the fixing bracket.
- Compressing the joint.
- Taking out the segments.
  As the segments are positioned in front of the TYTON sealing ring, they do not come into contact with the transport medium and can be removed by hand without any special tools.
- Pulling the pipes apart.
- Rough cleaning of the pipes and supports for their next implementation on the land of a water treatment plant.
  Once they have been checked, these pipes can be used again for wastewater pipelines and so be sustainably used again and again.

Connection between two buffer elements.

Tightness testing of the interim pipeline section by section.

Everything went perfectly

As regards time taken, handling characteristics, sustainability (they can be reused and are environmentally compatible) as well as security during operation, ductile iron pipe systems with BLS® push-in joints are the best alternative for the construction of interim pipelines.

The ductile iron pipe systems can be supplied with specific linings for fresh water (see EN 545 [5] or wastewater see EN 588 [6]).

The corresponding technical rules and regulations are being prepared by Berliner Wasserbetriebe; they also contain theoretical principles for planners.

Keywords

Interim pipeline, cast iron pipe systems, BLS® push-in joint, pipeline laid above ground

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Jürgen Rammelsberg

The right pipe in the right bedding

Coatings for ductile iron pipe systems

Cast iron pipes were the basic stock when it came to the installation of urban drinking water supplies 150 years ago. Further developments have continually been made to the material, joint technology and manufacturing process. With increasing requirements from users for efficiency and simultaneously increasing chemical and mechanical loads, an innovative foundry industry responded with some sophisticated solutions.

The most striking step was taken about 60 years ago: the invention of spheroidal graphite cast iron – known in the piping industry as ductile cast iron – with its dramatically increased strength wall thicknesses and hence the weight of the pipes was finally able to be halved.

Shortly after this, modern methods of protecting pipes and fittings against external chemical influences were developed. These arrived in parallel with the more recent advancements in construction technology where, with trenchless installation and replacement processes, both joining technology and external protection were able to meet new technical challenges.

Just as important are the mechanical interactions between the pipeline and its bedding. Standards EN 805 "Water supply – Requirements for water supply systems and their components outside buildings" [1] and EN 1610 "Construction and testing of drains and sewers" [2] contain comprehensive requirements for the bedding material which, if followed, should mean that damage to pipeline components is avoided. Thus, the development of "liquid soil" became a focal point of research and development at the IAB (Institut für Angewandte Bauforschung Weimar gGmbH) for many years.

Focal points of more recent developments for protection against external chemical influences

With the introduction of ductile iron pipes in the 1960s, on the basis of extensive tests, it was assumed that the new material would equate to the old grey cast iron in terms of corrosion chemistry. This was the time when the health-related ban on the use of tar became effective and resulted in the use of bitumen paints. In aggressive soils, external coating with "bitumen paint" was no longer sufficient and at the beginning of the 1970s it was replaced by the "zinc plus bituminous finishing layer" system. Initially it consisted of a 130 g/m² layer of metallic zinc with a coating of bitumen paint at least 70 µm thick. Later, this zinc layer was increased to 200 g/m². In around the year 2000, this was supplemented by a zinc-aluminium layer of 400 g/m², with a finishing layer of epoxy paint.

The protective effect is based on the position of iron and zinc in the electrochemical series of metals: when the coating is damaged, zinc ions go into solution and are precipitated onto the damaged iron, acting anodically, as hydroxide and carbonate with an increase in volume; the damage scars over and is protected in the long term under the conditions stated.

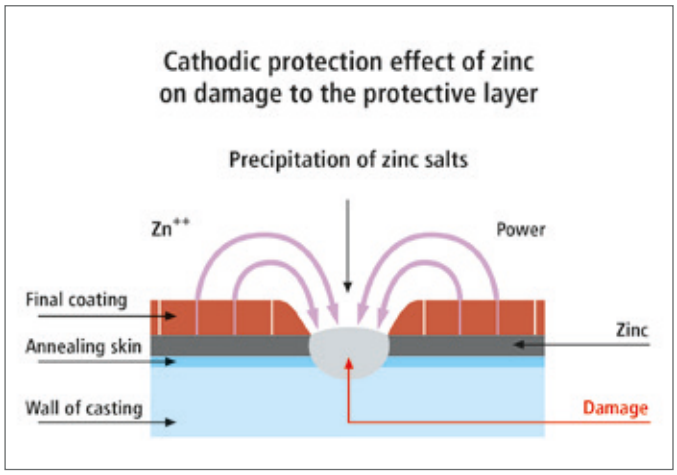
Naturally, this process only occurs if the stated reaction products of the zinc are insoluble in the soil electrolytes. This is so in most cases, in particular if the pH value of the soil electrolytes is above 6.5. In boggy and marshy soils with their acidic water, the zinc ions remain in solution and the protective mechanism is inhibited.

Thick coatings have been developed for these soils which act as barriers and separate the iron from soil electrolytes with a very high electrical resistance. Table 1 shows the coatings which have been standardised for cast iron pipe systems in Europe.

Self-healing of synthetic damage by zinc reaction products.

Coating numbers 1 to 5 acting as electrochemical barriers can be used in soils of any kind, but they must be free of pores and damage.

A fibre-reinforced cement mortar coating to EN 15542 [3] has a hybrid status. It is 5 mm thick and is applied to the galvanised pipe with an organic adhesive primer. With a polymer-modified mortar, the adhesive primer can be omitted. Both versions can be used in all soils. A cement mortar coating is extremely mechanically robust and has proved its worth above all with the trenchless technique, where sharp obstacles often lie undetected in the ground where the pipe is to be laid. But also, with installation



Cathodic protection effect of zinc on damage to the protective layer.

Application of a shrinking sleeve.

Table 1: Type of external protection for ductile iron pipe systems.

No.	Description	Standard	Application
1	Polyethylene	EN 14628 [4]	Pipes
2	Polyurethane	EN 15189 [5]	Pipes and fittings
3	Epoxy	EN 14901 [6]	Fittings and valve bodies
4	Enamel	EN ISO 11177 [7]	Fittings and valve bodies
5	Fibre-reinforced cement ortar	EN 15542 [3]	Pipes

in alpine areas to which it is almost impossible to transport bedding sand, the excavation material from the trench with coarse, sharp-edged stones and boulders can be used again as backfill.

While the fundamental developments of modern corrosion protection systems for buried steel and cast iron pipelines were coming to a temporary end in the middle of the 1980s, experience concerning optimum protection in different soils had also reached the stage that specific rules and regulations could be produced on this range of topics. First and foremost, this includes a determination of the corrosion likelihood for unalloyed ferrous materials depending on the most important soil parameters. This began as early as 1971 with DVGW worksheet GW 9 "Evaluation of corrosion risks of buried pipelines and vessels in unalloyed and low-alloy ferrous materials in soils" [8]. After 14 years of experience with the application of this data sheet, DIN 50929-3 "Corrosion of metals – Corrosion likelihood of metallic materials when subject to corrosion from the outside – Part 3: Buried and underwater pipelines and structural components" [9] was able to be published.

The experiences gained from the application of DVGW worksheet GW 9 are reflected the fact that, of the determining parameters available, only those which have proved able to be determined in practice have been adopted. Soil condition has been more sharply defined and given additional weighting on the basis of experience. Also, parameters which, in themselves, cause very high corrosive behaviour have been given more weight: soils with a high content of organic substances and contamination due to fuel ash, waste, scrap, effluents, coal and coke.

Table 2 in DIN 50929-3 [9] contains the important soil parameters which can be determined in soil samples in the laboratory. In some cases here, the values measured are arranged in groups with increasing values. For each group, an evaluation number Z_n for n laboratory parameters is then produced.

Evaluation numbers Z_1 to Z_9 (laboratory values) are added together and give the evaluation number total B_0.

Observations of local circumstances include criteria such as the position of objects with respect to the groundwater, inhomogeneity factors due to the vertical and horizontal soil stratification and potential measurements for determining external cathodes. The final result is the evaluation number total B_1.

The outcome of the system analysis with parameters which are quantitively determined both on soil samples in the laboratory and on features of local circumstances is a tabular classification into four soil classes with an increasing corrosion likelihood for the free corrosion of unalloyed and low-alloy ferrous materials (Table 3).

Of practical importance for the choice of suitable external protection of ductile cast iron pipes, fittings and valves is the classification of soils into four soil classes from

Table 2: Data for evaluating soils (soil samples in the laboratory).

Z	Feature and measured value	Requirement or criterion	Testing	Unit	Measurement value range	Evaluation
Z_1	Soil type – cohesiveness	Proportion of elutriable particles	Method DVGW GW 9: 2011-09, Annex B, Module 5	Mass proportions in %	< 10 10 to 30 30 to 50 50 to 80 > 80	**+4** **+2** **0** **–2** **–4**
	– Impurities	DIN EN 12501-2:2003-08, Table 1				**–12**
Z_2	Specific electrical soil resistance	Lowest resistance after addition of water, measured in the cell	Method DVGW GW 9: 2011-09, Annex B, Module 2	Ω m	> 500 200 to 500 50 to 200 20 to 50 10 to 20 < 10	**+4** **+2** **0** **–2** **–4** **–6**
Z_3	Soil humidity and reference for Z_6 to Z_{10}	Water content after drying at 105 °C	Method DVGW GW 9: 2011-09, Annex B, Module 1	Mass proportions in %	< 20 > 20	**0** **–1**
Z_4	pH value	pH value with 50 % proportion of water	Method DVGW GW 9: 2011-09, Annex B, Module 2	–	> 9 6 to 9 4 to 6 < 4	**+2** [a] **0** **–1** **–3**
Z_5	Buffer capacity – alkalinity $K_{S\,4.3}$	Acid capacity to pH 4.3	Method DVGW GW 9: 2011-09, Annex B, Module 4	mmol/kg	> 1000 200 to 1000 < 200	**+3** **+1** **0**
Z_6	Buffer capacity – Acidity $K_{B\,7.0}$	Base capazity to pH 7.0	Method DVGW GW 9: 2011-09, Annex B, Module 5	mmol/kg	< 2.5 2.5 to 5 5 to 10 10 to 20 20 to 30 > 30	**0** **–2** **–4** **–6** **–8** **–10**
Z_7	Sulphate-reducing bacteria	Sulphide content	Method DVGW GW 9: 2011-09, Annex B, Module 6	mg/kg	< 5 5 to 10 > 10	**0** **–3** **–6**
Z_8	Sulphate content	Sulphate	Method DVGW GW 9: 2011-09, Annex B, Module 4	mmol/kg	< 2 2 to 5 > 5 to 10 > 10	**0** **–1** **–2** **–3**
Z_9	Neutral salts	Chloride and sulphate content in the watery extract	Method DVGW GW 9: 2011-09, Annex B, Module 3	mmol/kg	< 3 3 to 10 10 to 30 10 to 100 > 100	**0** **–1** **–2** **–3** **–4**

practically non-aggressive to highly aggressive (Ia to III). For pipelines, permanent tightness has priority. Here it is the speed of wide or deep pitting corrosion which is of decisive importance.

Once the classification of a soil had been established with the help of a type of system analysis, all that was now missing as a link to the type of protection for metallic pipelines mentioned above was a technical rule with which the aggressiveness of the soil surrounding a pipe route could be assigned to a pipe coating to match it. This was DIN 30675-2 [10] for ductile iron pipes and for steel pipelines it was DIN 30675-1 [11]. In the revised version of DIN 30675-2 [10] issued in 1993,

Table 2 (continued): Data for evaluating soils (local circumstances).

Z	Feature and measured value	Requirement or criterion	Testing	Unit	Measurement value range	Evaluation
Z_{10}	Position of the object to the groundwater	Groundwater in existence	Visual	–	never always sometimes	**0** **–1** **–2**
Z_{11}	Soil homogeneity horizontal based on soil resistance profile	Fluctuations in soil resistance	Method DVGW GW 9: 2011-09, Annex A	–	$\lvert\Delta Z_2\rvert < 2$ $2 \leq \lvert\Delta Z_2\rvert \leq 3$ $\lvert\Delta Z_2\rvert > 3$	**0** **–2** **–4**
Z_{12}	Soil homogeneity vertical	Difference soil resistances	Method DVGW GW 9: 2011-09, Annex A	Mass proportions in %	$\lvert\Delta Z_2\rvert < 2$ $2 \leq \lvert\Delta Z_2\rvert \leq 3$ $\lvert\Delta Z_2\rvert > 3$	**0** **–1** **–2**
Z_{13}	Soil homogeneity – bedding	Same type of soil or sand	Visual	–	homogenous	**0**
		"Elements external to the soil such as wood, roots or soils with characteristics as per DIN EN 12501-2:2003-08, Table 1"			inhomogenous	**–6**
Z_{14}	Soil homogeneity – different pH values	Anthropogenic influences e.g. impurity with demolition, limed soils	Method DVGW GW 9: 2011-09, Annex B, Module 2	–	$\lvert\Delta Z_4\rvert < 1{,}5$ $\lvert\Delta Z_4\rvert \geq 1{,}5$	**0** **–6**
Z_{15}	Presence of external cathodes	Object/soil potential $U_{Cu/CuSO4}$	Method DVGW GW 9: 2011-09, Annex A	V	< –0,5 –0,5 bis –0,4 –0,4 bis –0,3 > –0,3	**0** **–3** **–8** **–10**

[a] Only for homogenous bedding. For inhomogenous bedding (different pH values) Z_{14} applies.

Table 3: Soil classes, corrosion levels and probability of corrosion for the free corrosion of unalloyed and low-alloy ferrous materials.

B_0 - or B_1 values	Soil class	Corrosion level[a]	Corrosion likelihood based on the B_1 values	
	based on the B_0 values		Wide or deep pitting corrosion	Surface corrosion
0	Ia	very low	very low	very low
–1 to –4	Ib	low	low	very low
–5 to –10	II	medium	medium	low
< –10	III	high	high	medium

the areas of application for the different coatings were extended to include the term anode backfill. This documented the fact that, in addition to the coating, the bedding of a pipeline is also part of the passive corrosion protection system and should be taken into account in the areas of application.

The experiences gathered were reflected in a first revision of DIN 30675-2 [10] in 1993 and a second one in 2019. The main tool in this standard is the allocating Table 4.

Table 4: Areas of application for buried ductile cast iron pipes with coatings.

No.	Coating	Layer thickness or surface-related mass	Recommended coating for the joint areas	Anode backfill	Areas of use Soil classes
1	Coating in zinc or zinc-aluminium alloy with or without other metals with final coating to EN 545 and EN 598	Zink[d], 200 g/m² or	None	without	I, II
		ZnAl[d], 400 g/m²		with	I, II, III[b]
2	Cement mortar coating to EN 15542	5,0 mm	Heat-shrink material or coating DIN 30672-1 – C-50M[a] or rubber sleeves	without	I, II, III
3	Polyethylene coating to EN 14628	"1,8 mm to 3,0 mm"	Heat-shrink material or coating DIN 30672-1 – C-50M[a]	without	I, II, III
4	Polyurethane coating to EN 15189	700 µm	none [c] or DIN 30672-1 – C-50M[a,c]	without	I, II, III

NOTE: Corrosion protection materials to DIN 30672-1 can be used for the coating of ductile iron pipes and fittings outside the area of the pipe joint.

a In case of long-term operating temperatures T ≤ 30 °C, for the pipe joint, coating to DIN 30672-1-C-30M may be used, or in case of low mechanical loads, e.g. to DIN 30672-1-B-30M.
b Not suitable in case of continual exposure to eluates with pH < 6 and for peaty, boggy, muddy and marshy soils
c See pipe ends as per EN 15189
d Design types and areas of use of other options for zinc and zinc-aluminium coatings are specified in the information annexes of the product standards.

The correct choice of external protection for ductile iron pipe systems against chemical attack in a self-contained set of technical rules is relatively simple, particularly if, when considering the local circumstances, it turns out that route is recognisably contaminated with organic admixtures. Z_1 (Table 2) then shows a value of –12, whereby the soil in class III is characterised by a high corrosion risk and a high probability of pitting corrosion. The thick coatings listed in Table 1 are then to be selected without any further soil investigations.

When an anode backfill consisting of class I soil material is used, the zinc-based corrosion system can also be used in so far as footnote b to Table 4 is observed.

Section 8.4 of DIN 30675-2 [10] contains supplementary protection measures for fittings against cell formation with external cathodes and concrete thrust blocks.

Protection against mechanical loads

The system of ductile iron pipes, fittings and valves is, in itself, very robust and does not need any particular mechanically effective external protection unless local circumstances demand a high level of protection against corrosion.

The shortage of sand as a bedding material which has been looming meanwhile has, in the revised version of EN 1610 [2] resulted in recycling materials being permitted for the first time among the construction materials delivered. Also, the reuse of the excavated soil is allowed as long as it does not contain any elements which might damage the pipe.

In this sector, cement mortar coating to EN 15542 [3] has prevailed, being able to be used in all class I to III soils according to Table 4, line 2. In addition, this extremely robust coating allows bedding in soils with stones of up to 100 mm in size, as described in Annex G of DVGW worksheet W 400-2 [12].

The use of ductile iron pipes with a cement mortar coating is to be considered sustainable for several reasons:

Table 5: Annex G DVGW worksheet W 400-2: Guidelines for materials in the pipeline zone excluding the street environment.

Pipe material		Coating	Minimum layer thickness of bedding	Grain size round material with graduated grain size to DIN EN 1610 [mm]	Grain size broken material with graduated grain size to DIN EN 1610 [mm]
Ductile iron pipes		Bitumen	min. 0.15 m [3]	0 / 32 [5] max. 63	0 / 16 [5] max. 32
Steel pipes and ductile iron pipes		PE – N [1]	min. 0.15 m [3]	0 / 8 [5] max. 16	0 / 5 [5] max. 8
Steel pipes and ductile iron pipes		PE – V [1]	min. 0.15 m [3]	0 / 8 [5] max. 16	0 / 5 [5] max. 10
Steel pipes and ductile iron pipes		ZM	min. 0.15 m [3]	0 / 63 [5] max. 100	0 / 63 [5] max. 100
PVC-U pipes, PE 80 and PE 100 pipes, PE 100 pipes with protection properties, PE – Xa	≤ 200		min. 0.15 m [3] [4]	0 to 22 [4]	Crushed sand/grit mixture 0 to 11 [4]
	> DN 200 ≤ DN 600			0 to 40 [4]	
GRP pipes			min. 0.15 m	[2] < DN 200:2/8 > DN 200 ≤ DN 400:2/8; 8/16 > DN 400 ≤ DN 1000:8/16 > DN 1000:8/16;16/32	

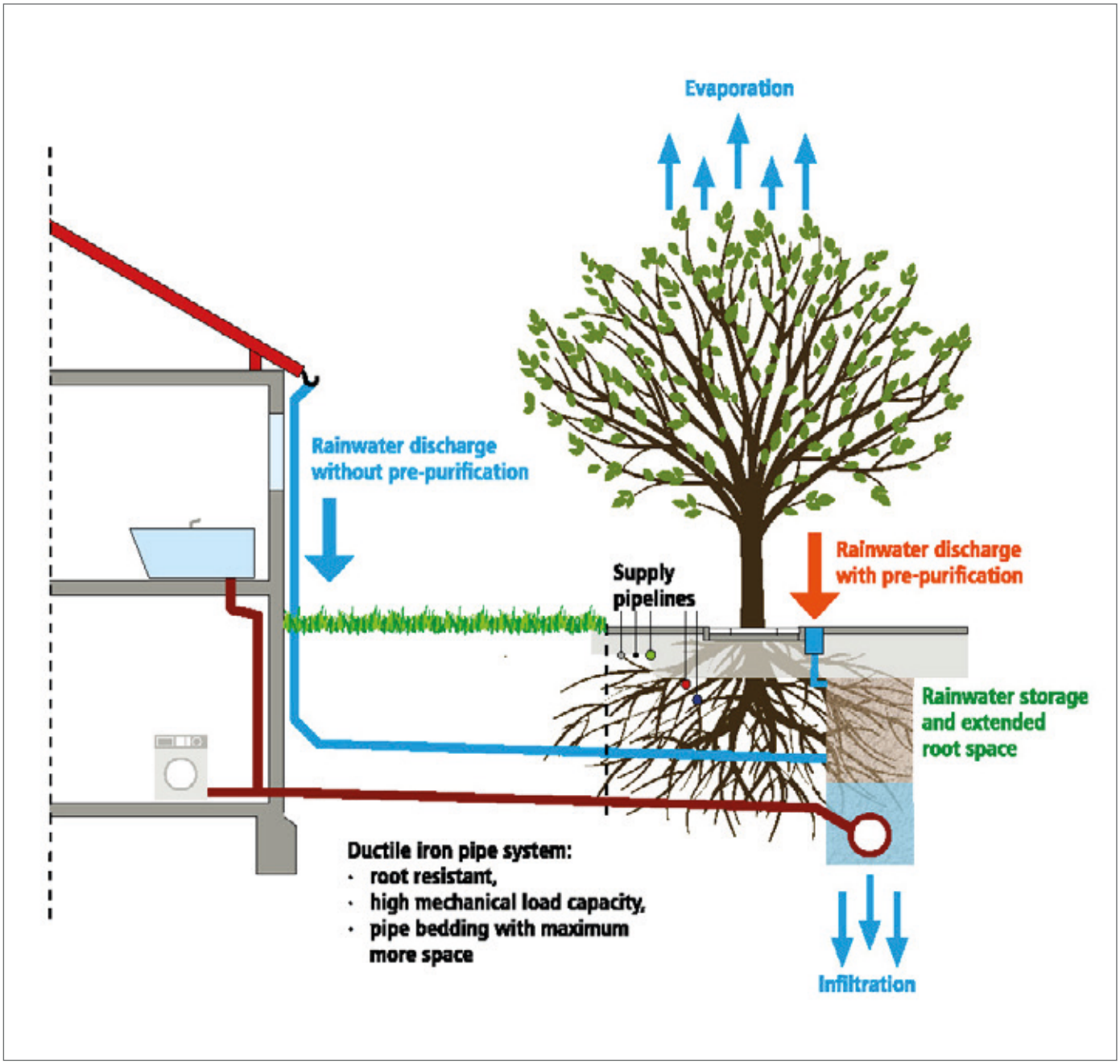
1. The reuse of trench excavation material saves both its transport away from the site and the delivery of bedding sand to the site, which means that additional HGV traffic, including the CO_2 emissions associated with this, is avoided. When constructing water pipelines in Alpine areas for turbine pipelines and snow-making facilities, the transport of material is very much restricted and often well-nigh technically impossible. In these cases, the coating according to EN 15542 [3] is so robust that bedding the pipes in the existing rocky screen has become common practice.

2. Bedding in coarse ballast opens up an entirely new application option for the ductile iron pipe with a coating of fibre cement mortar: with the sponge city principle, a pipe trench filled with coarse ballast can be used as linear intermediary storage for rainwater at times of heavy rainfall which is available to trees in urban areas for a longer period. The proven root resistance of the cast iron pipe joint means that a tree can be planted directly on the route of the pipeline. This application offers two simultaneous climate-related effects:

a) Avoidance of flooding by the intermediate storage of rainwater.

b) Improved growth conditions for street trees with the associated improvement of the microclimate because of the increased evaporation performance of their healthier crowns.

3. The development of trenchless installation and replacement techniques has been significantly influenced by ductile iron pipes with restrained joints. Here one can really talk about a bedding with more or less unknown properties. In a borehole strengthened with bentonite there can actually be anything which a pipe pulled through it might come up against, such as sharp stones, sharp-edged remains on foundations, fragments of grey iron in the case of burst lining etc. The list can easily go on. Ductile iron pipes with cement mortar coating have won through for these techniques with "unknown bedding" right along the pipeline.



The sponge city principle at street level.

Conclusion

The statements about external protection of ductile iron pipe systems against chemical and mechanical stresses show that sustainable construction of pipeline for water and wastewater is possible with any type of bedding material.

Keywords

Cast iron pipes, external chemical influences, mechanical interactions, thick coating, soil classes, corrosion risk, corrosion likelihood, external protection

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Manuel Görzel

A challenge: leak detection on long-distance pipelines

Correlating dataloggers supply astonishing results

The locating of leaks on long-distance pipelines is one of the major challenges for service providers and measuring instruments. With the "Ortomat MTC" correlating datalogger and the Hydroport system from the vonRoll hydro company some astounding results can be achieved.

The monitoring of drinking water transport pipelines across long distances presents numerous challenges: in contrast to local networks, there are usually only a few access points to the pipeline, meaning that measurement sections can extend over extremely long distances. In the circumstances, leak noises are not picked up or, because of the insufficient radio range of the correlators, cannot be measured. Added to this there are the different operating states of the pipelines – from standstill to high volume flowrates, occasionally also with widely fluctuating pressure ratios.

Transfer structures with interference noises from pumps or pressure reducers represent further challenges. Additionally, smaller losses of water are usually not recorded at all by the water meters as these fall below the measurement range of the metering devices.

Correlation with noises

The "Ortomat MTC" correlating dataloggers offer several advantages which make leak detection on such pipelines easier – and, in fact, possible in some cases where it was previously not possible at all. Correlation is done with noises which are recorded at night. This means that ambient noises from traffic and similar are minimised.

Correlation over 1,988 m in the Hydroport.

A direct line of sight, as needed by normal correlators between the two transmitters, is not necessary thanks to the automatic synchronisation of the datalogger. This means that the dataloggers can also be used independently of each other and so bridge long distances.

The following data are recorded by the noise loggers:

1) lowest noise level at night
2) noise level every 30 min
3) nightly noise recording at 2 am to listen and correlate

The first step is to evaluate the noise. Are there any particularly loud sections in the pipeline? However, especially with long measurement distances, often over 1,000 m, the noise level is only one indicator of a leak. In this case, correlation of the noise recorded at night is particularly helpful. Under good conditions (ambient noises, pressure in the pipeline) the correlation makes some astonishing measurement results possible with pipeline lengths of up to 2,000 m. On the basis of the measurement results, a rapid pinpoint location of the leaks can then be carried out on the spot, for example using ground microphones.

Practical examples

The Oberfranken water supply company (FWO) in Kronach

There was a known leak on a DN 500 (ductile cast iron) transport pipeline with a small volume of water escaping to the surface. The measurement points were located 924 m and 1,066 m from the leak. Measurement conditions were good: the pipeline is in a rural, field area and the pressure was approx. 6 to 7 bars. Once the measurement section had been installed and set up in the Hydroport, good measurement results were able to be achieved even by the 2nd day. In the end it turned out that the leak was just 2 m away from the correlation result; with a measurement distance of almost 2,000 m, a creditable result! For the human ear, however, there was no perceptible leakage noise at either of the measurement points, even with a listening device. After excavating it was found that a collar with screwed socket joints had started

Correlation along the railway line in the Hydroport.

Leaking joint on a collar.

On-the-spot confirmation of measurement results with a ground microphone.

Ortomat MTC (O4G), correlating noise logger.

to leak, probably because of subsidence. The water loss was around 2 to 5 m³/h.

The Siegen-Wittgenstein water association (WVS)

A pilot project has been carried out by the Siegen-Wittgenstein water association in which numerous sections of pipeline were checked; happily, most were without findings. But here again, good measurement results were able to be achieved. The first leak was measured on a section of pipeline which crosses a motorway and a very busy main road between two access points. Despite two changes of material (AZ-GGG-AZ) and radio connection being made impossible by buildings and noise protection barriers, a leak was successfully able to be detected. The "Ortomat MTC" was set up in the existing manholes by the motorway and in the main road; the pipe cover depth was approx. 6 m. Meanwhile the WVS has repaired the leak. The point along the trench determined by leak detection lay precisely above the damage location.

A second leak was able to be detected with pinpoint precision alongside a railway line. The distance between the measurement points here was 467 m. This was a pipeline of DN 200 ductile iron pipes of the first generation with inadequate corrosion protection. The repair, which was initiated immediately, was successfully achieved.

Conclusion

Correlating noise loggers make effective monitoring of drinking water transport pipelines possible. This means that, in the context of noise transmission, amazingly long measurement distances are investigated, which would have been unthinkable with previous methods.

In addition, the measurement results are continuously documented in the Hydroport. If it should actually come to cases of major damage, the constant monitoring of the pipeline can be documented for insurance purposes.

Keywords

Leak detection, leaks, Hydroport, datalogger, noise logger

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Roland Gruber

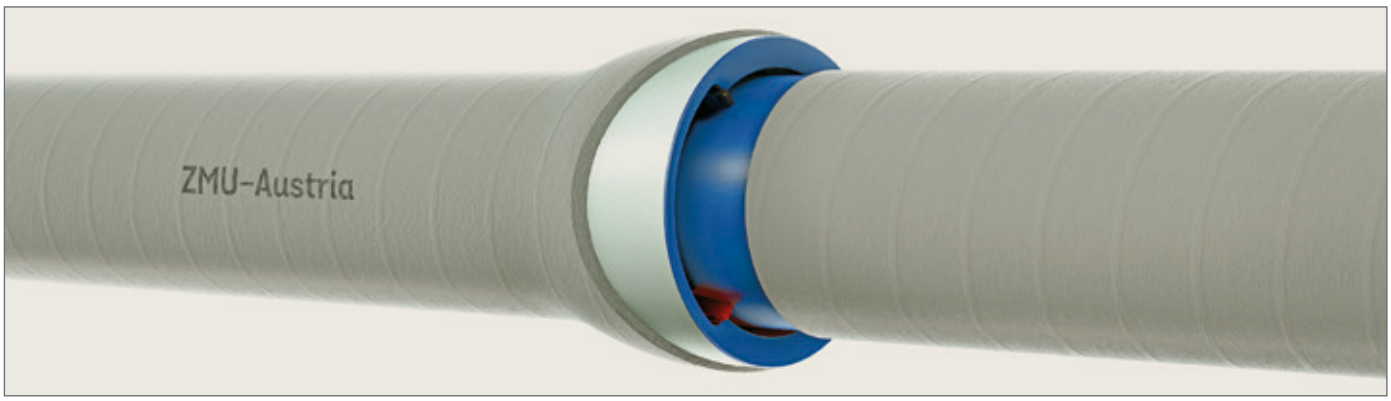
Quality leap for TRM cast iron pipes

Innovative coating technology is another milestone

For the traditional manufacturer of ductile iron pipes based in the Tyrol – Tiroler Rohre GmbH – the emphasis is consistently placed on innovation and further development. For two years, the TRM research department was working together with an Austrian cement producer on a new type of fibre cement mortar for the external coating of pipes. Since autumn of last year, two machines have been set up in the factory in Hall, Austria which make the almost fully automatic wrapping of pipes with the new type of fibre cement mortar possible. Currently, the first pipes to be coated in this way are rolling off the production line. Thanks to the new type of coating, the pipe system offers not only the highest level of chemical and mechanical protection, but also some tangible economic advantages.

The fact that, for more than 70 years, Tiroler Rohre GmbH has been able to maintain its high quality level is due not least to the innovative spirit consistently encouraged. In the past, the engineers of this traditional company have again and again succeeded in developing "their" product further and bringing new innovations onto the market. A bold and willing attitude to innovation has turned the ductile iron pipe from TRM into what it is today: a pipe system which sets the standards in matters of robustness, durability and efficiency.

The most recent result of in-house development work is called "ZMU-Austria". ZMU is the German abbreviation for cement mortar coating and this is a technique developed by the company for applying the coating to the pipe using the extrusion process. *"We have invested around two years of development*



Together with a partner from the Austrian cement industry, TRM has developed an innovative fibre cement coating. Meaning that, once again, the Tyrolean company is setting the standard in matters of resistance and durability.

The roughness of the galvanised outside surface helps the new type of cement mortar to adhere to the pipe in the best way possible.

The fibre cement coating is applied in a thickness of 5 mm in a fully automatic extrusion process.

Two wrapping machines which, in recent weeks, have been optimally adapted to the production processes, are capable of coating pipes from DN 80 to DN 1000.

work into this project, which was only possible thanks to the outstanding collaboration with our partner of many years in cement technology. The aim here was this: to develop a cement mortar which, on the one hand, offers the highest degree of external protection for the pipe and, on the other hand, is easily implemented in production. We have succeeded in this", summarises a happy engineer Christian Auer, head of Quality Management at Tiroler Rohre GmbH.

The cement mortar layer is partially removed for attaching the TRM tapping sleeve.

Once cut, the cement mortar layer can easily be taken out using a hammer and chisel.

Adhesion without adhesives

A further challenge in the development of the new cement mortar consisted of creating the ideal adhesive power of the material onto the cast iron pipe. *"It was extremely important to us that we should achieve adhesion of the cement entirely without bonding agents. Firstly, an adhesive involves the additional use of a chemical substance, secondly it involves application of the adhesive in production, which is an additional step in the process, and thirdly it was also necessary to avoid too strong an adhesive on the pipe as this also has to be cut on the construction site and it must also be possible to remove the coating"*, explains Christian Auer. He refers to the specific roughness of the zinc layer on the surface of the pipe, which is applied first, and which basically presents good conditions for the adhesion of the cement.

The fact that the new pipes with the "ZMU-Austria" cement mortar coating are produced entirely without bonding agents is so far a unique selling point on the market. In its production, the special cement mortar is extruded over a mesh bandage on the pipe and smoothed out at the same time. This production stage is done automatically. It was only in autumn that special machines were acquired for this and these were adapted to the needs of the production process in close collaboration between TRM and the Austrian machine manufacturer. *"Since we have eradicated the initial teething troubles, production can now really begin"*, says Christian Auer.

Complex composition – profound protection

If we consider the ductile iron pipe with the new ZMU-Austria cement mortar coating in terms of its composition, we can talk about three layers which go around the pipe: on the inside it is lined with a cement mortar produced from Portland, blast furnace, alumina or plastic-modified cement. Outside this, the first layer consists of a fine zinc overlay applied at in 200 g/m². The outermost protective layer now presents the new, 5 mm thick fibre cement mortar coating. The socket end-face and spigot end remain free of cement mortar and instead are provided with the tried and tested PUR or epoxy coating. *"We recommend that special rubber or shrink sleeves are used at the construction site for the joint areas so that the whole of the pipeline receives optimum protection"*, explains Christof Mairinger, BA, MBA, Marketing Manager at TRM.

Obviously, they did not want to have one of the greatest strengths of the ductile iron pipe – namely its flexibility – restricted by the cement coating. Even in the ZMU-Austria version, the pipes still have an elastic deformability of 3 % to 5 %, depending on the diameter.

Chemical resistance

Another important characteristic which they wanted to give the new fibre cement mortar is found in its chemical resistance. Specifically, this concerns a highly alkaline composition which, beyond a pH value of 10, prevents corrosion of the iron. *"The fibre cement mortar which we have developed also has a very high sulphate resistance. This means that the new pipe system offers maximum protection in very aggressive, contaminated soils with a high sulphate content"*, explains Christof Mairinger. Thanks to its safe electrochemical properties, the ZMU-Austria pipe can also be used in the area of influence of stray currents.

Here the Marketing Manager pointed out another particular characteristic on the outermost surface of the cement coating: *"Because of the carbonatation on contact with the surrounding environment, the cement hardens even more on the surface and forms an impermeable, resistant and water-repellent layer."*

Mechanical protection

However, the obvious quality lies in the mechanical protection provided for the pipe. The 5 mm thick layer of fibre cement mortar makes sure that the pipe does not suffer any damage during storage, transport and, naturally, also during installation. The last point also has a role to play with trenchless installation above all, where great loads are put on the pipe during the pulling-in process. The cement mortar coating surface protects it against damage.

Because of the high mechanical strength, no special bedding material is needed; as a rule, the excavation material can be used as the bedding material.

The multitalented ZMU-Austria is absolutely predestined for use in Alpine and mountainous areas. Thanks to its high mechanical robustness, almost any excavation material can be used for the bedding zone, where the inclusion of stones in sizes up to 100 mm are permissible. Christof Mairinger: *"The advantage of this pipe being able to be used extremely well in mountainous areas is that no additional bedding or backfilling material is needed. In addition, there are also no disposal costs for the excavation material as it can indeed be reused. The economic advantage is evident. But, in this connection, the ecological factor should not be forgotten either: by putting back the original excavation material, the natural structure of the soil is retained at the location. A point which comes up again and again when environmentally relevant questions are discussed."*

For additional protection for the sockets, the use of a special sheet-metal cone is recommended when using the trenchless laying technique.

Naturally, ZMU-Austria pipes can be secured just as easily with the tried and tested locking segments. Spigot end and socket area remain free of the cement mortar coating.

Because of its outstanding suitability for pipeline construction in Alpine areas, the ZMU-Austria is the pipe of choice when it comes to pressure pipelines for hydropower stations, but also for snowmaking equipment.

Urban applications

But, of course, it is not only for the construction of pipelines in mountainous areas that extreme resistance and long working life are advantages which are increasingly in demand. *"There is one thing here which should not be forgotten: naturally it makes a difference whether trees are cleared in a forest area because a pipeline has to be replaced after just 20 years or perhaps only after 100 years. But the question becomes more delicate in highly built-up urban areas. One only has to think about the fact that simple plastic pipes in urban areas often need to be replaced after less than 20 years – with all the consequences which that brings for traffic and the entire infrastructure. Therefore, in this area too, the kind of durability offered by the TRM pipe plays an important role"*, argues Christof Mairinger.

In the urban environment there could be a further and very useful application possibility for the new pipes in the near future: under the technical term "sponge city", Christoph Bennerscheidt, Managing Director of the European Association for Ductile Iron Pipe Systems, has developed a solution for cooling in urban centres which are becoming increasingly hot. *"In order to cool town and city centres*

naturally in the future, we will rely more intensely on green spaces where trees will be planted. In so doing, the roots of the trees will be given sufficient space in coarse-grained ground so that the surface can absorb more water, which also achieves beneficial effects for our increasingly severe precipitation events. Of course, only pipes which are 100 % root resistant can be used here – such as our new ZMU-Austria pipe", says Carina Kirchmair from Application Technology at TRM. A pilot project of this kind should be launched in the near future in a large city in Austria.

Improved ecological footprint

With all innovations in the TRM company, questions of sustainability and the ecological footprint play a major role. According to the Marketing Manager, this is a key concern for the executive. So, it is therefore no wonder that the new ZMU-Austria pipe also sets standards in this respect. *"Basically, for our ductile iron pipes, we exclusively use recycling material which we obtain from the immediate vicinity. Added to this is the fact that, thanks to our photovoltaic system with a 9,000 m² collector surface (the largest rooftop system in the Tyrol), we use energy produced by ourselves, thus making a considerable contribution to environmental protection. Also, any by-products are utilised: the best example is our waste heat, which is fed into the Hall district heating system. The ecological footprint of the ZMU pipe has of course been markedly minimised by the fact that the pipe no longer has to be coated by an outside service provider. As of now, all this happens here at our factory."*

Solution for practical questions

In this way, the traditional company can still react quickly and flexibly to client requests. TRM does in fact have a very well-stocked warehouse, but in practice this ability to process special requests rapidly is necessary again and again. *"With the two new coating systems we are in a position to carry out the pipe coating operation within a few days. Theoretically we can also recoat pipes which have already been coated, if this is wanted"*, explains Christian Auer. In this connection, Christof Mairinger points out the great importance of the in-house application technology, which repeatedly responds to practical enquiries and so drives the further development of the product forward. *"Our great strength is our closeness to the client. Our marketing team are technicians who are able to offer the client advice and assistance. Their feedback offer gives us an important stimulus for the further development of our pipes. Our research department is therefore also given consistent support by the management in its innovative drive."*

All dimensions available

The most recent result of this research and development work is thus the new ZMU-Austria pipe which, because of its resistance, is suitable for both pressurised and gravity applications. All approvals and certificates are available for this. *"We did not invent the cement mortar coated pipe, but we have pretty much perfected it"*, says Christof Mairinger, and not without pride. At the moment, the factory in Hall has two coating units at its disposal: one for dimensions DN 300 to DN 1000 and the other for DN 80 to DN 600. By the middle of the year, all pipe sizes within this range will be available with ZMU-Austria coating.

Also new here is an improvement in traceability and the recording of process data. Currently, each individual pipe which leaves the factory in Hall bears its own QR code, which makes automatic identification possible. This means that there is seamless documentation and traceability providing information on when and in which series the pipe was produced. The ZMU-Austria pipe from Tiroler Rohre GmbH is a further milestone in the technical development of the cast iron pipe in Austria.

Keywords

ZMU-Austria pipe, innovative coating technology, ductile iron pipes, ecological footprint

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A new transit pipeline for the Birs Valley

A secure drinking water supply even at times of flooding

Heavy rainfall in 2007

From the afternoon of 8 August 2007 until the morning of 9 August 2007, the volume of rainfall in the Swiss valley of the River Birs reached unexpected dimensions: between 90 and 120 mm of rain fell there in just 15 hours. "Normally this represents the total average rainfall for a month. The hydraulic catchment area of the Birs (Sorne, La Scheulte and Lützel) above Laufen is approximately 701 km². This means that an average volume of rain of 1,168 m³/sec was falling onto this area."

This was stated by the Basel-Landschaft Canton crisis team in its report dated 22 January 2009 on the devastating floods of 8/9 August 2007 [1], which caused major problems in more or less the whole of the Canton of Basel-Landschaft.

Fuel oil released into the Birs

In almost no time at all, the extreme rainfall of this night in August 2007 caused the level of the streams and rivers across the entire Canton of Basel-Landschaft to rise menacingly and burst their banks, flooding towns and villages. As a result, numerous and extensive releases of fuel oil also occurred. According to estimates, around 180,000 litres escaped into the environment, of which about 150,000 litres were quickly eliminated thus allowing even greater damage to be avoided. Around 30,000 litres of fuel oil were carried along with the Birs, flowing through the flooded area. As the fuel oil infiltrated the groundwater of the Birs in some places, and in particular close to the "In den Weiden" groundwater pumping station meaning that it had to be shut down, the neighbouring communities were no longer able to use it for treating their drinking water for days on end. Tankers now supplied drinking water to the communities affected.

After the flood

More than ten years later, the massive damage which the flood in Basel-Landschaft left behind it has more or less disappeared and been forgotten; around 120 million Swiss francs had to be spent to eliminate it.

When flood situations occur, especially if pollutants can be released into the river, drinking water supplies, pumps and treatment plants are put at risk in the short term and have to be taken out of operation. Such bottlenecks, or even total breakdowns,

The pipes had to be installed under difficult conditions: tight access ways, narrow trenches and closely braced trench walls. Nevertheless, their installation went without problem.

The different types of soil are clearly visible, but the ductile iron pipe with cement mortar coating is up to any situation. Unpolluted excavation material can also be used again for backfilling the trench.

The use of Roco Wave butterfly valves from Erhard on a DN 1000 IWB pipeline in a modified valve pit.

Transporting the pipes from the factory directly to the construction site.

should no longer happen in the future. But because the water supply to the communities of the Birs valley usually comes from only one "source", such as the Reinach and district waterworks (WWR), in the event of flooding a second water supply is needed.

In cooperation with the regional and communal water supply companies, the Canton is endeavouring to increase the security of supply in comparable situations by means of supra-municipal and regional management amalgamations.

A second pipeline

It took a long time, but all good things are worth waiting for: the decision to construct the so-called "Birs valley transit pipeline" along the River Birs – a generation project – was also taken after the flooding event of August 2007. In order to be able to react better to crisis situations like the one in 2007 and to guarantee security of supply for drinking water, the Reinach and district waterworks (WWR) decided to install a second water supply pipeline with a larger capacity as well as a new pumping station. The green light was given in August 2017.

The section of the new pipeline from Basel/St. Jakob to Münchenstein includes a 2.5 km long pipeline in DN 500 ductile iron pipes with cement mortar coating [2] and BLS® restrained joints, various installation and dismantling joints and Roco Wave electro-drive butterfly valves, all supplied by TMH Hagenbucher AG.

In January 2019 the water supply pipeline and pumping station were able to go into regular operation. A formal opening of the transit pipeline attended by the general public followed on 25 May 2019.

Keywords

DN 500 ductile cast iron pipes, transit pipeline, Birs valley, flood, cement mortar coating

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Spectacular pipe mounting in the vertical

Doubling the turbine output in Finhaut

A long-term project

After a little more than a year of construction time, in September 2019 the new hydropower station in Finhaut, Switzerland was able to be put into operation. However, achieving the Finhaut microgeneration unit took ten years overall: from project planning in 2008 until the start of construction work in summer 2018. The water from one stream and three wells was combined and then fed into the filling chamber of the microgeneration unit via a sand trap upstream.

The topography of the location and the geological conditions made things difficult for the engineers and technicians: *"Where the turbine hall is located, the slope is extremely steep. There was very little space for the installation of the entire plant, which was built on the rock"*, says Jérôme Antonin, Head of Project at the SEIC-Télédis group.

In 2009, a drinking water pipeline was laid along part of the road between Finhaut and Emosson in the Canton of Valais. Also installed in the trench for this was an empty plastic pipe, with the intention of later being able to use water from the "Le Besson" stream and the wells at Finhaut for turbines to generate power.

Only 200 m for 10 bars

In later years, various feasibility and viability studies showed that, with the help of the local conditions, the water pressure could be increased by 10 bars, thus enabling the turbine output to be doubled. However, to achieve this the turbine building had to be moved approximately 200 m.

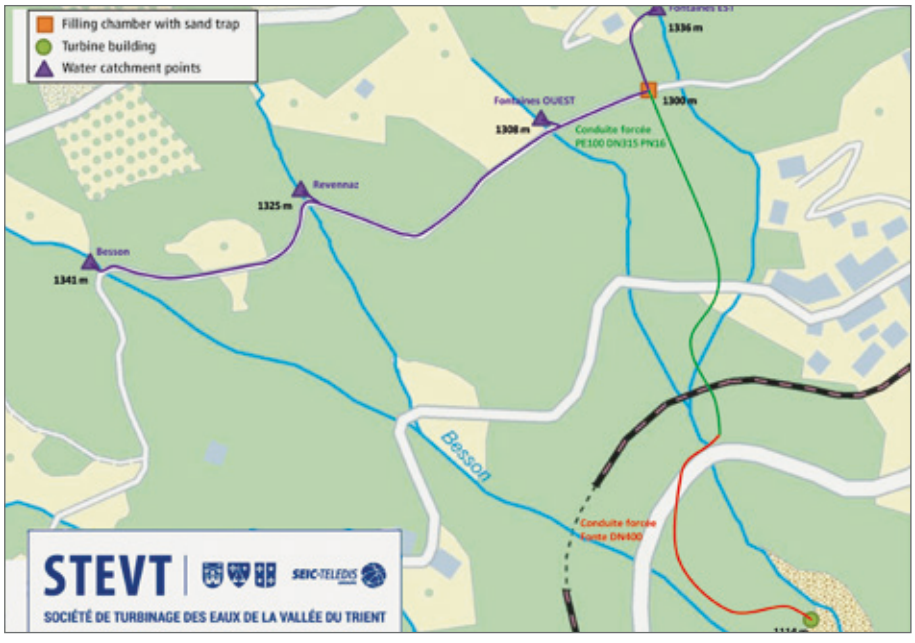
Complex challenges

In summer 2018, construction of the new pipelines could be started. In addition to the high water pressure which the pipelines had to withstand, those responsible for the project had to face a whole series of further structural challenges along the way. The open crossing of the stream, the crossing of the main cantonal road and, not least, the complex installation of the pipes in the lowest area with its almost vertically falling rockfaces – all this had to be overcome. These were all reasons why a pipe was sought which not only was able to take the high water pressures but was also easy to lay. The plastic pipe was definitely no longer a contender for this.

Pipes by helicopter

Against this background, the SEIC-Télédis group, which assumed responsibility for project planning and construction, decided in favour of using DN 400 ductile iron pipes with cement mortar coating [1] and BLS® push-in joints from the Hagenbucher company. Experiences with ductile iron pipe systems in similarly located projects had been very good and their use had proved successful. Thanks to the uncomplicated assembly, it was possible to assemble the pipes with restrained joints while they were still suspended from the helicopter.

Since September 2019 the plant has been generating power: with an output of around 420 kW, it will produce 1.2 GWh a year, which covers the needs of about 300 households. *"We are very proud of this performance"*, says Roland Voeffray, Chairman of STEVT *"which further increases the value of the natural resources of our valley and fulfils the targets of the Energy Strategy 2050, which aim at increasing local hydropower production"*. A project which also harmonises with the Energy Strategy of the community



The way in which the turbine building was moved about 200 m downwards is marked in red.

Open stream crossing with thrust blocks on both sides.

The relocated and newly established technical building in poorly accessible terrain with an almost vertical feed pipeline.

Full physical involvement in the steepest of terrains. The BLS® push-in joint from Hagenbucher can take the vertically acting tractive forces without problem. The pipes were flown in by helicopter.

The project in numbers

3 million SF:	the budget for construction
423 kW:	electrical output of the plant
1.2 GWh:	expected annual production
3,000 households:	electricity consumers
186 m:	steep slope location
425 m:	length of the cast iron pressure pipeline
2 million m³:	turbine volume

of Finhaut. As a "sustainable village" in the Mont Blanc region, Finhaut is working to promote renewable energies.

The Hagenbucher company is grateful to all participants in the project for the confidence placed in it and the good cooperation.

Keywords

DN 400 ductile iron pipes, steep slope, turbine construction, cement mortar coating

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Owner
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Groupe SEIC-Télédis, Vernayaz

Engineering
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Installation
Pierroz Christophe SA, Martigny-Croix

Christoph Bennerscheidt

Implementing the sponge city principle

It is time to act

The effects of climate change have been more noticeable than ever before in Europe and also in Germany over the last couple of years. Long periods of high temperatures in combination with low rainfall in the spring and summer of 2018 put a strain on us humans and also had visibly harmful effects on the natural world.

The summers of 2018 and 2019 from a meteorological viewpoint

Some indications of the effects can be seen from the German weather service analyses for 2018: according to these, with a mean temperature of 10.5 °C, 2018 was the hottest experienced so far in Germany since regular records began in 1881. What is striking was the long-lasting drought from February to November. The combination of high temperatures and low precipitation makes 2018 a particularly exceptional year. And a new record has also been set for hours of sunshine: in the period from the end of July to the middle of August, very high temperatures were recorded which often went above the 30 °C mark. When compared with the long-term reference period of 1961–1990 there has been a positive deviation of +2.3 Kelvin [K]. By the end of November 2018, the total precipitation figures were also on the way to setting a record: the year 2018 takes 4th place for dryness after 1959, 1911 and 1921 in the records since 1881 [1].

In 2019 a new national record was set for heat in Germany: from 24 to 26 July an exceptional heat wave prevailed in the West of the country over three consecutive days with maximum temperatures of over 40 °C; the first time in this country since systematic weather records started to be taken. New record figures have been set at various measurement stations with a national all-time record of 42.6 °C on 25 July 2019 at the Lingen weather station in Emsland. In other countries in western Europe too, e.g. in the Netherlands, Belgium and Luxembourg, numerous local and other regional records have been registered [2].

The extent to which the annual rainfall levels in 2019 should also be assessed as being too low overall will only be seen from the evaluations at the end of the year. However, one thing can be stated right now: the long-term effects of too little rainfall in 2018 and the lack of precipitation in the first half of 2019 were already apparent in the hot summer months of 2019 and will have long-lasting effects. Forest owners have already taken the view that we are talking about a century catastrophe.

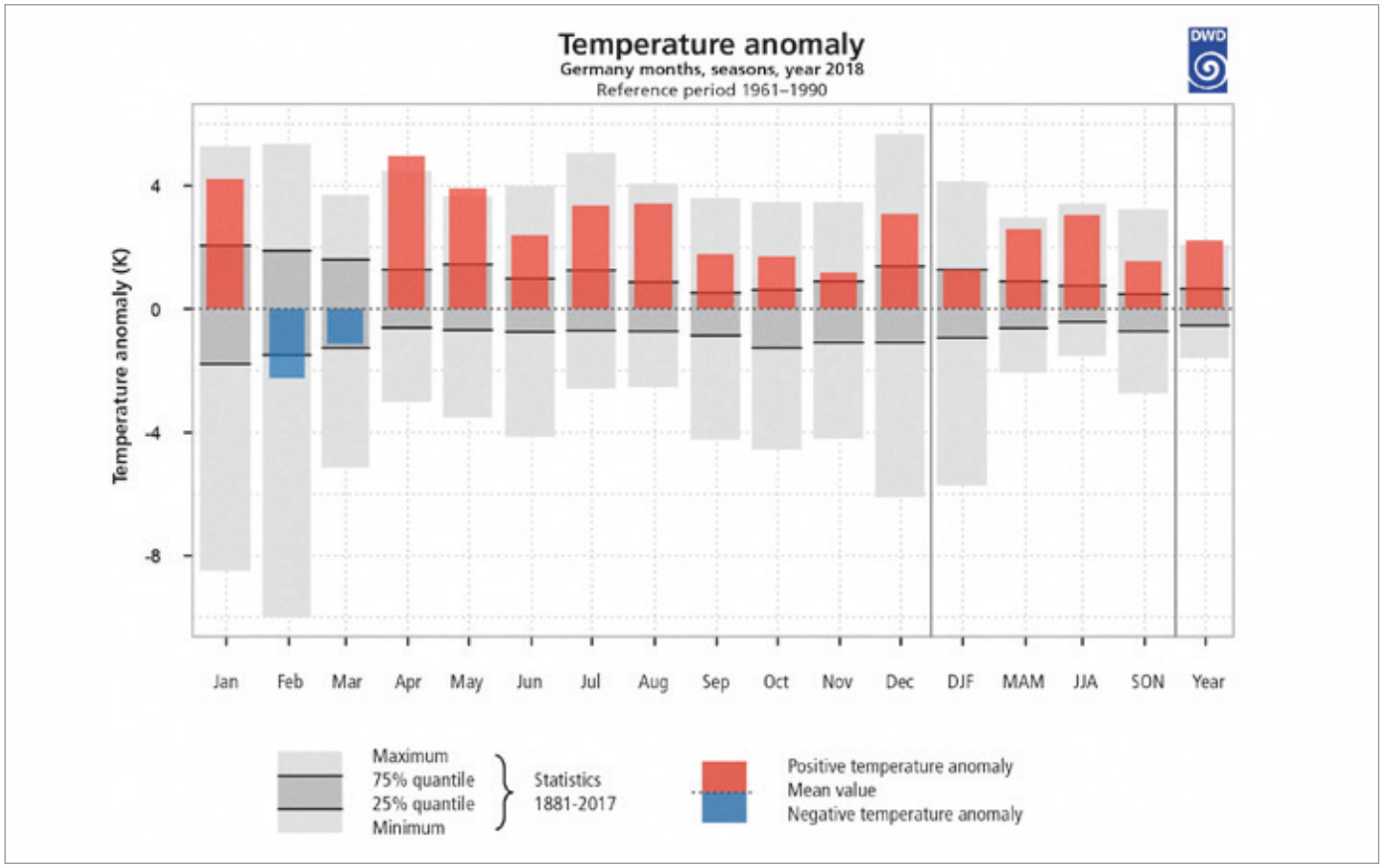
The effect of long-lasting drought on urban trees

Even more severely affected by drought were urban trees in parks and along roadsides. Anyone could easily see that things were going badly for the trees by the leaves drooping limply, curling up, discoloured yellow or falling from the trees, so that local authorities were calling on townspeople to water the trees in their street. Both municipal employees and residents irrigated the trees with drinking water. Using tankers and buckets, water was poured directly around the trunk so that trees, whose roots had not yet managed to leave the far too meanly dimensioned planting pit, could be safely supported. Older trees, for which it can be assumed that they too were planted in tree pits which were too small but whose roots – which draw up water and nutrients – have nevertheless managed to extend beyond the planting pit, definitely did not benefit from this irrigation water. In addition, the deeper lying layers of soil in towns and cities dried out, with this effect being reinforced by the high degree of sealing and reduced groundwater formation.

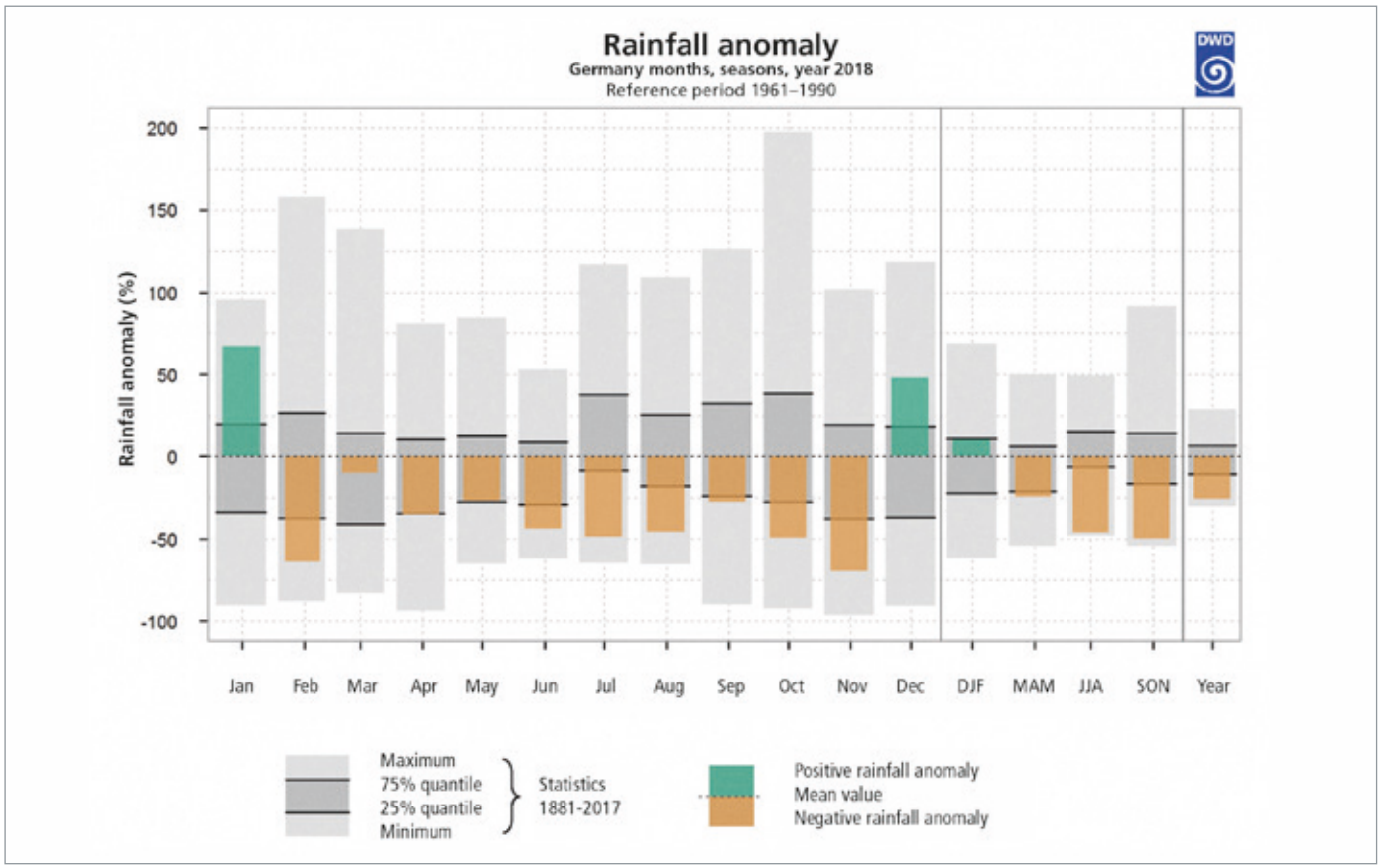
The effect of construction methods for tree pits on urban tree vitality

At an early stage, a great pioneer of the sponge city idea, Klaus Schröder, already pointed out the consequences, and also the background, of tree pits which are designed to be too small. He did this, for example, in a speech at the Austrian tree forum in Vienna on 26.03.2009 [3], [4]:

Naturally, and particularly in times when the coffers are not exactly overflowing with money, the question is posed of whether the expense needed today for optimising the location of trees makes sense. But such planting, done for reasons of sustainability and durability, is only "expensive" at first glance. Because: who is not familiar with the sight of those pitiable specimens in "cheaply" prepared locations which waste away after just a few years, in the proverbial "too little to live, too much to die" situation, in order finally, a few years later, to need replacing. If one really thinks about the false investment in this type of tree planting, the return on the capital employed, the cost of years of pointless care and finally one takes account of the expenditure for replacement with new trees, one must



Temperature deviation across Germany in a statistical comparison over many years. This shows the values in 2018 with reference to the values in the period in 1881 to 2017. Picture source: [1]



Rainfall deviation across Germany in a statistical comparison over many years. This shows the values in 2018 with reference to the values in the period in 1881 to 2017. Picture source: [1]

become convinced that the outlay for providing the best growth conditions is, even under economic aspects, a good capital investment. Even disregarding the unfulfilled function for which the trees were originally planted.

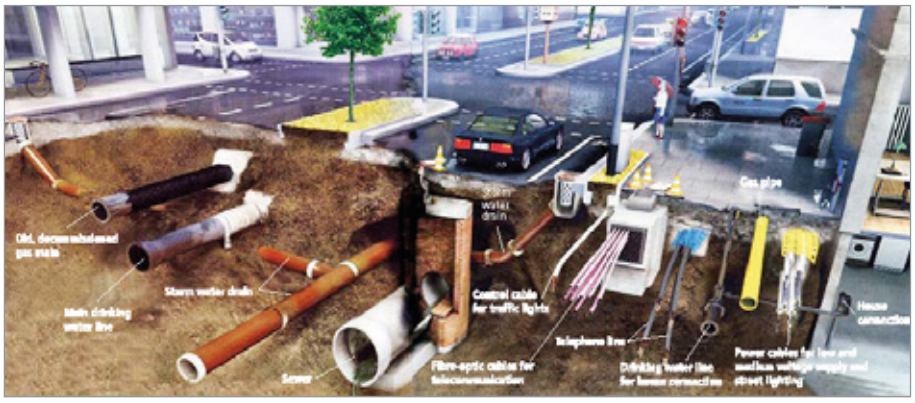
Vital trees and reduced maintenance costs are achievable targets which make up for the additional initial expenditure for optimally planned planting. However, the necessary investments should be made at the time of planting and not some time afterwards in order to correct mistakes. When planting trees in towns and cities, the latest findings as regards planting technique / construction technology must be taken into account and put into practice!

Presentations like these have also contributed to the fact that planting techniques for trees have developed further. Tree pit methods have been developed for planting trees with substrates which ensure ideal soil aeration in the root space. The fact that rainwater can be used to irrigate the urban trees planted in this way is obvious. The so-called "Stockholm solution" [5], a synonym for a method of planting in tree pits in which highly compactable coarse ballast forms the support structure, combines the elements of root space and storage space for rainwater. As a result, the maintenance costs for urban trees are already reduced.

The sponge city principle

But this method goes much further: in a report by the Bundesinstitut für Bau-, Stadt- und Raumforschung (BBSR) on provisions for flooding and hot weather by means of urban development [6], these methods are described as the so-called sponge city principle. It is the aim of these modified applications to make the surfaces of towns and cities more suitable than ever for taking up and storing rainwater. By this type of nearly natural rainwater management, green spaces can become natural "refrigerators" for the town, in that they have a sufficient supply of water. This cooling capacity can be increased by the storage of rainwater, measures to improve the soil and a constant supply of water to the vegetation. The promotion of the sponge city principle and the development of sustainable storage and irrigation systems are therefore described as central tasks for the future for climate-adapted towns and cities [6].

With a view to the effects of long-lasting dry periods on urban trees described in the introduction it seems logical to enlarge the root spaces and their space for storing rainwater further. A seemingly unsolvable task in the urban underground space if one thinks of the intensive uses to which this is put. However, it does become solvable if this construction method can be used in the pipeline trenches of drains and sewers.



An example of use of the underground street space.
Picture source: RWE-Magazin June 2006, modified by K. Schröder

Ductile iron pipe systems – solutions with a robust soil-pipe system

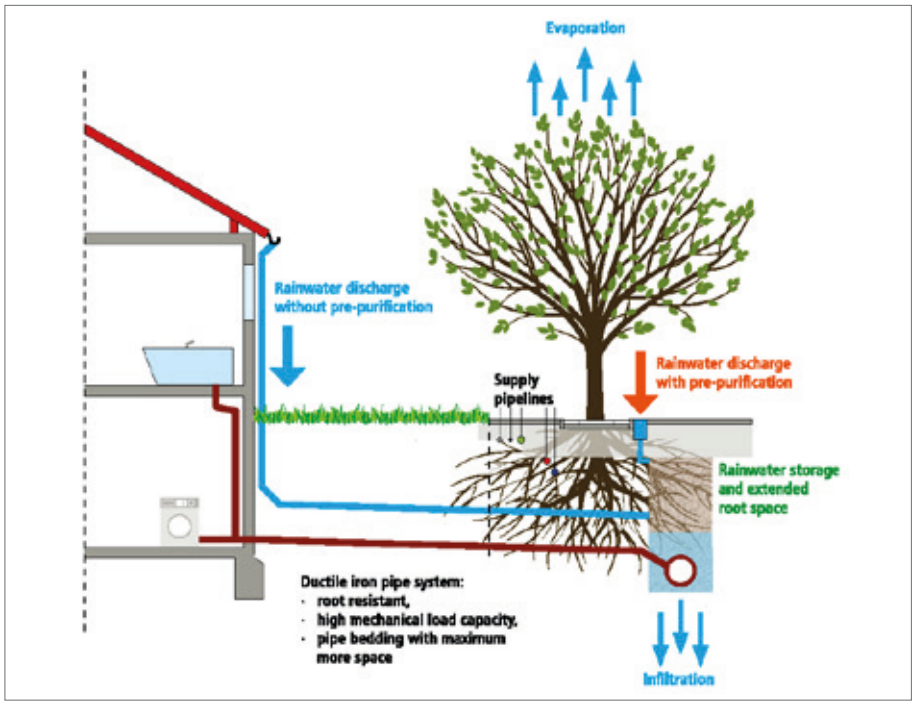
A pipe system which is able to be installed in this coarse bedding material is produced from ductile cast iron to EN 598 [7] and protected with a cement mortar coating to EN 15542 [8] against corrosion and mechanical loads. The TYTON®, type push-in joints used are root-resistant and impervious to external water pressure.

Cement mortar coating can be used in broken bedding material with a maximum aggregate size of up to 63 mm and individual pieces of max. 100 mm diameter [9].

With the soil-pipe system, the pipeline trench with the ductile iron pipes beneath the road becomes a means of storing rainwater. Water from non-polluted surfaces, such as roof areas (with the exception of roofs with copper or zinc coverings), can be directly fed into this storage space. Polluted rainwater will first be treated and then introduced into the rainwater storage space. For example, DIBt-certified systems which are available on the market can be used for treating the water. The water is either used to irrigate the tree roots growing in the pipeline trench or it trickles away as in an infiltration ditch system.

Summary

The effects of climate change have been more noticeable than ever before in Europe and also in Germany over the last couple of years. Long periods of high temperatures in combination with low rainfall in the spring and summer of 2018 put



The sponge city principle in the street space. By the use of large-grain, broken materials with a large storage volume, the soil in the pipeline trench becomes a rainwater storage space and provides extended root space.

a strain on us humans and also had visibly harmful effects on the natural world. It is now time to act!

Structural solutions for these tasks have been developed in recent decades. The application of the sponge city principle has become feasible: the civil engineering for the planting of urban trees has been further developed and, with the soil-pipe system for ductile iron pipes as described, a possibility has been demonstrated for incorporating the so far unused large volume of pipeline trenches into the planning as well. We have to act now in order to make the urban infrastructure climate-proof too. With the inclusion of urban green spaces in the planning of underground infrastructures, there will be room to manoeuvre which must be put to good use.

Keywords

Sponge city principle, soil-pipe system, tree pits, climate change, urban trees, ductile iron pipes, drought

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Gennady Walder

Ductile cast iron pipe as a problem solver

A jack of all trades with many advantages

The Devoll hydropower project in Albania

The company undertaking the project, Devoll Hydropower Sh.A. (DHP), is an energy company active in Albania with its head office in Tirana; the umbrella organisation is Statkraft AS based in Oslo. DHP was originally a 50/50 joint venture between Statkraft AS and the Austrian energy company EVN AG in Maria Enzersdorf. In March 2013, Statkraft AS took over the 50 % shares of EVN AG and is now the 100 % owner of the company and the project.

In the context of the Devoll project, Statkraft AS is building two hydropower stations on the River Devoll, some 70 km to the South-East of the Albanian capital of Tirana: Banjë and Moglicë. The two together will have a capacity of 256 MW and an annual production of around 729 GWh. The Banjë power station took three years to build and was put into operation in 2016; for the Moglicë power station, commissioning was planned for 2019.

The power generated by the two hydropower stations is badly needed in order to meet the sharply increasing power consumption in Albania. On completion, Devoll Hydropower will increase the generation of renewable, clean power in Albania by 17 %.

The Devoll Hydropower project is one which has been well thought out and well planned and which is being implemented according to international best practices. It offers the best financial, technical, environmental and economic designs with some important advantages as regards energy, flexibility in production and supply, regional economic development, job creation as well as diverse advantages for the communities concerned. In addition, this means that DHP will be contributing to an improvement in road transport in the project area in that more than 100 km of roads and bridges will be newly constructed or extended.

A view from the dam down to the emergency spillway.

Deflected pipes in the curved course of the tunnel.

An assembly team installing a DN 800 pipe.

A view from the temporary storage area for pipes to the dam and emergency spillway.

New decision at short notice

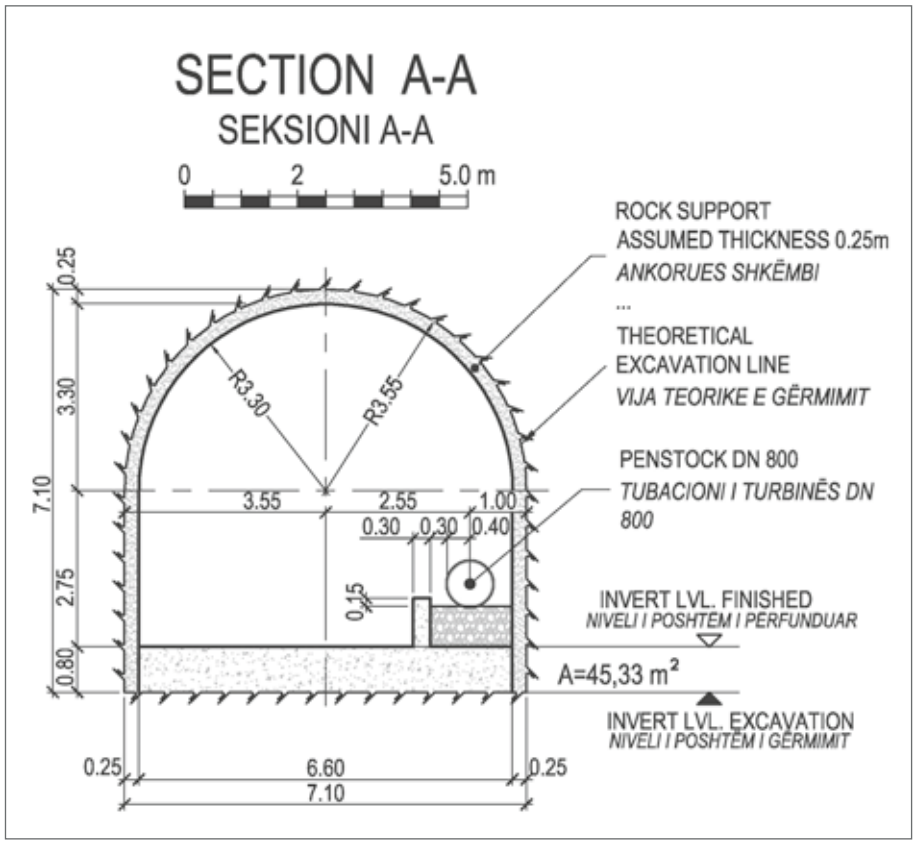
The power station at Moglicë, with a height of 186 m, is the highest dam of this type in the world. A lake surface of 7.2 km² with a volume of 360 million m³ is being dammed. The water will be routed via a 10.7 km long headrace tunnel to the underground hydroelectric power station with two main Francis turbines from General Electric.

A third Francis turbine will operate via a piping section at the foot of the 186 m high barrage so as not to entirely cut off the water supply in the project area. In order to keep the impacts of the construction project on the environment as low as possible, an attempt was made to install a steel pipeline using the microtunnelling technique. Unfortunately, this attempt failed right at the starting pit because of the difficult and complicated geological conditions there. It was therefore decided, at short notice, to install the pipeline directly in the supply tunnel. This meant that the length of the DN 800 turbine pipeline increased to an overall length of 354 m, measured from the barrage wall to the turbine house.

Cast iron pipes instead of steel pipes

The original plan to construct the pipeline using steel pipes was discarded not only due to the complex geological conditions but also because producing the welding seams was too expensive and would have taken too much time. Also, because

From the barrage wall to the headrace tunnel.



Cross-section of the supply tunnel with DN 800 turbine pipeline (penstock).

Working in restricted spaces: Top left: transport for assembly with a telescopic handler. Bottom left: concreting work.
Right: DN 800 turbine pipeline after installation in the setting-up area of the supply tunnel.

of various changes of direction, a few pipe bends would have to be produced on the construction site.

In the search for alternatives and in order to solve the problems they were facing, the Turkish general contractor Limak turned to the Duktus company. What they were looking for was a pipe system with which the entire turbine pipeline could be constructed simply, safely and in highly restricted spaces.

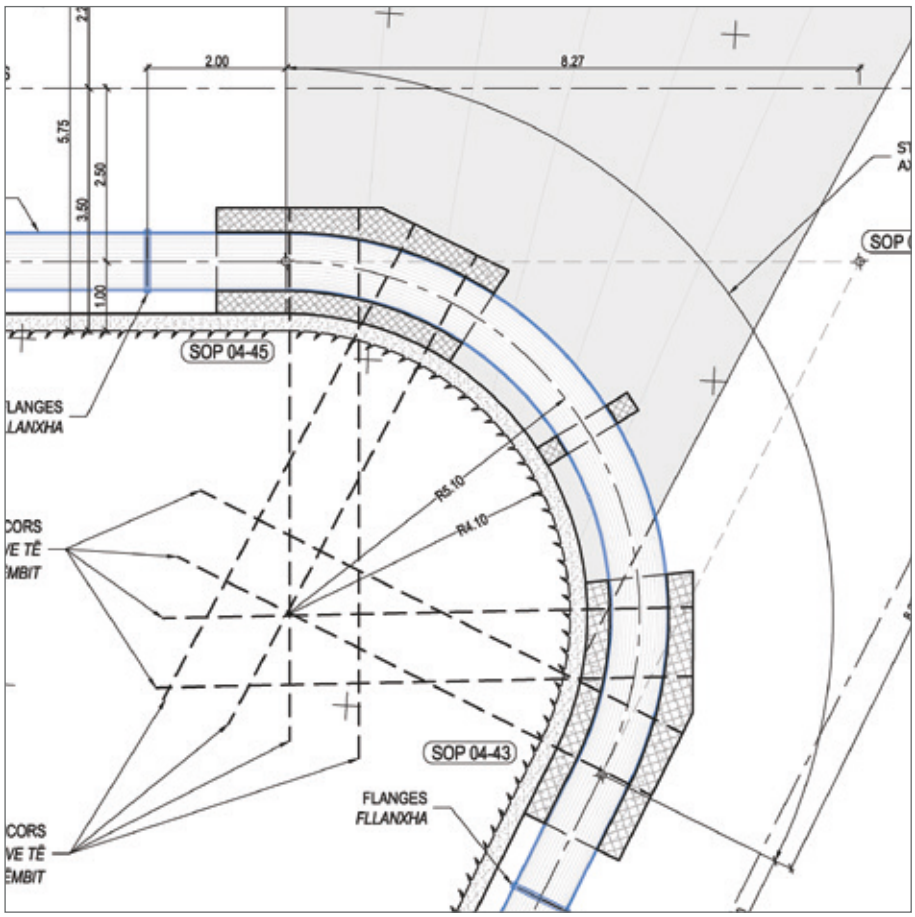
The safety factors had to be given priority and the changes of direction in the route needed to be secured with thrust blocks. Included among the selection criteria were, among other things, the possibility of vehicle impact protection and resistance to the earthquakes which can occur in this region.

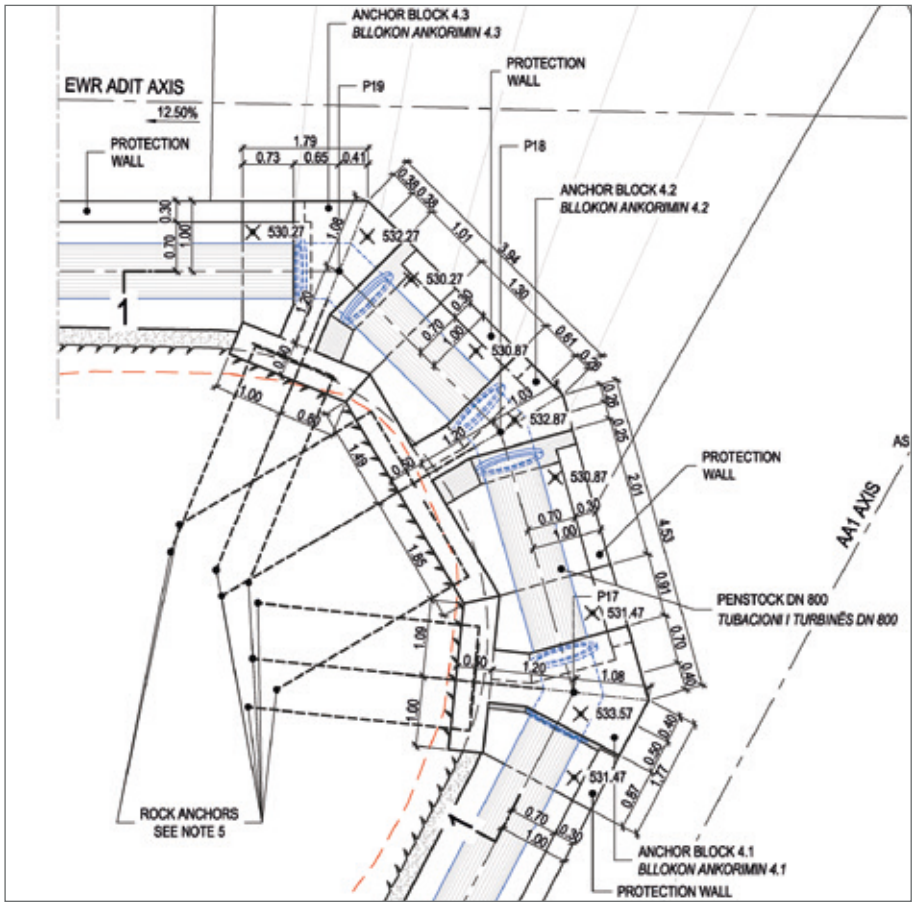
The decision went in favour of ductile iron pipes with the proven BLS® restrained pipe joints.

No compromises even under pressure

The Norwegian client Statkraft AS is known for its high safety standards and does not accept any compromise in the selection of pressure classes either. For the entire 354 m, pipes with wall thickness class K10 with BLS® restrained joints, suitable for PFA = 25 bars, were selected. The resulting pressure results from the geodetic height difference of 138 m. With a closing time of 6 seconds for the guide vanes at the turbine in the centre of the power station a theoretical pressure increase of 20.4 % is calculated; with an additional safety margin of 10 %, this results in a permissible component operating pressure (PFA) of 18.3 bars. For wall thickness class K10, the PFA = 25 bars.

The first-draft plans envisaged mounting the pipes on brackets. These would absorb any possible subsidence or landslides. Changes of direction along the pipeline route, which were originally planned with steel pipe bends, were now able to be dealt with easily and without problem with the ductile iron pipes and the use of plain ended pipe sections and standard fittings.





Directional change in the supply tunnel.
Top: the plan with a welded steel pipe bend. Bottom: execution planning with plain ended pipe sections (spigot end to spigot end) and double socket bends.

Mastered together

Construction site briefing and monitoring was attended by the application technology people from the Duktus company at the site in Albania. With the help of the briefing, the Limak assembly team was able to lay a pipe system, which was initially completely unfamiliar to them, to a quality level considered excellent by all participants.

The team around Erion Hysa was cautious at first but in the later stages they achieved a daily rate of up to 20 joints. By a skilful arrangement of the plain ended pipes included in the delivery into prefabricated lengths, the number of cuts on site with new welding beads was able to be reduced to a minimum.

Keywords

Turbine pipeline, BLS® restrained-joint, hydropower plant, Albania, Moglicë hydropower station

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Roger Saner

Anergy networks with ductile iron pipes

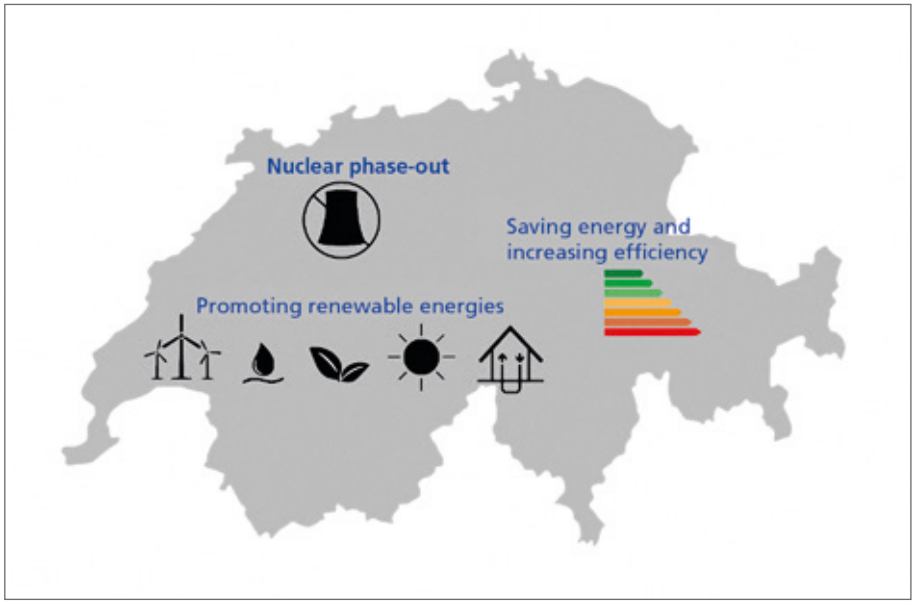
Energy-efficient water transport

Swiss Energy Strategy 2050

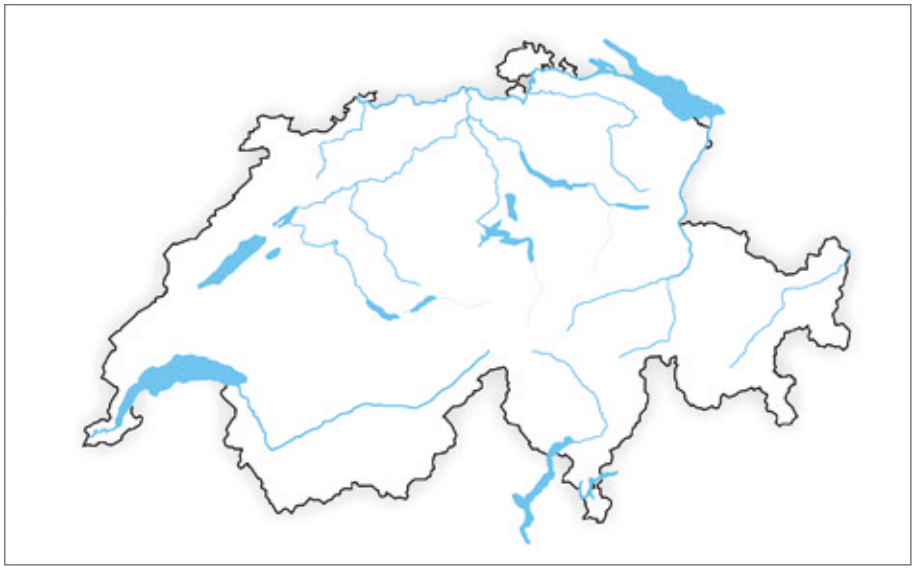
The Swiss Energy Strategy 2050 was adopted by the referendum on 21 May 2017. Its main focus lies in the use of local, renewable energy sources.

The most important aims of the Swiss Energy Strategy 2050 are a sustainable guarantee of energy supply, consistent development of existing energy efficiency potentials, reduction of CO_2 emissions and full utilisation of existing potentials of new renewable energy sources. So, in Switzerland, the final energy consumption (final energy = primary energy after energy conversion and transmission losses) per person should decrease in the medium term to 2035 by 43 % and in fact in the long term to 2050 by 54 % as compared with the base year of 2000.

When considering new renewable energy sources, the thermal utilisation of water and wastewater – in so-called Anergy networks for heating or cooling buildings – offers enormous potential. With the continued technical development of heat pumps and heat exchangers, a serious improvement has been achieved in their efficiency levels, which makes these technologies very interesting for the utilisation of heat from water and wastewater.



Map of Switzerland with the targets of the Energy Strategy 2050.



Distribution of the major lakes and rivers in Switzerland.

Thermal utilisation of lake and river water

With the aims of a sustainable supply of energy and a reduction of CO_2 emissions, the use of heat or cold from lakes or rivers is increasingly attractive. Since the larger Swiss lakes – such as Lake Constance, Lake Neuchâtel, Lake Zurich, Lake Lucerne or Lake Geneva – are also the locations of larger towns, it is precisely here that using the enormous heat potential of the lakes is a must.

Utilising heat from wastewater or industrial process water

Wastewater is considerably warmer in winter and cooler in summer than the air outside and so can be used for heating or cooling buildings. A precondition for an economical use of energy from wastewater and process water is the proximity

of the energy consumers to a large sewer, a sewage treatment plant or the industrial plant using the process water. The most suitable candidates for using the energy from this type of water are large buildings with a high energy requirement, such as administrative buildings, schools or housing estates.

The technology of heat and cold recovery

Anergy networks are a combination of pumping stations, heat exchangers, a network of pipelines and heat pumps, by means of which the energy in water or wastewater can be used. These days the recovery of heat and cold respectively by heat exchangers and the recovery by compression and expansion by heat pumps into heating energy and for water heating are simple, tried and tested technologies which, in many cases, are very economical and competitive.

In order to generate power, a lot of energy is needed to drive the pumps in the piping network, which places high requirements on energy efficiency and particularly on the hydraulic capacity of the pipe material used. Pressure and/or energy losses can be reduced to a minimum by selecting the ideal pipeline dimensions and by the choice of pipes with a hydraulically smooth internal lining.

Anergy network – energy production in the low temperature range

An Anergy network is a low temperature network for supplying low-temperature energy from waste heat or from renewable sources. It consists of a closed-circuit system, often designed as double pipelines for feed and return flows as well as inlet and outlet pipelines to the heat pumps in the buildings.

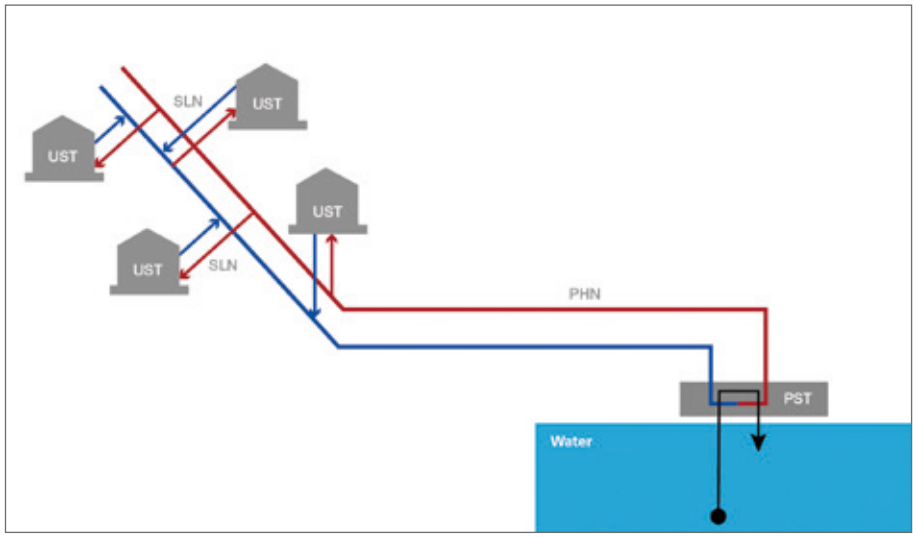
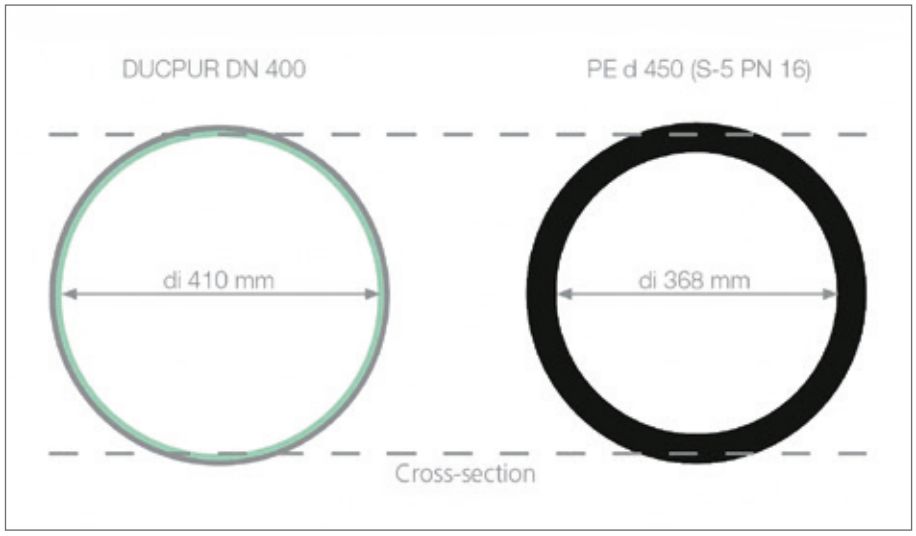


Diagram showing an example of an Anergy network.



Comparison of hydraulically usable internal diameters. The cast iron pipe with PUR lining has a considerably larger hydraulically usable internal diameter (less pumping energy needed).

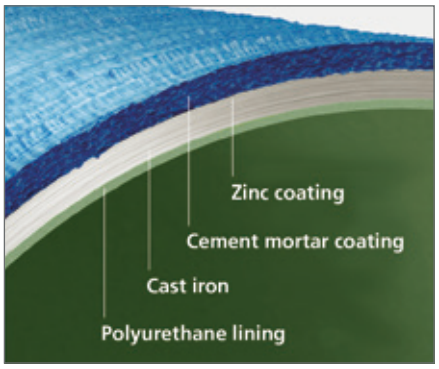
Ductile iron pipes with polyurethane lining promote energy efficiency

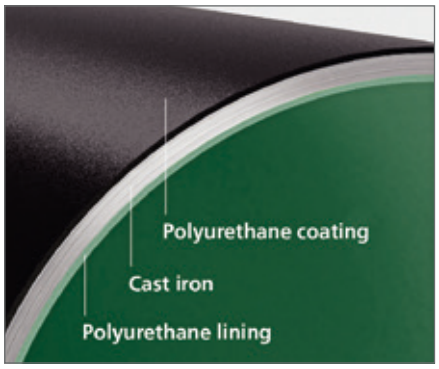
For the construction of the pipeline system, high operational reliability, economical operation and a long service life are decisive criteria when selecting the suitable pipe material.

Ductile iron pipes with their outstanding properties offer enormous advantages:

- very long useful life of up to 140 years
- maximum static load-bearing capacity
- ease of handling and processing
- the vonRoll push-in joint systems guarantee a 100 % tight connection of the pipeline to the closed water circuit
- standard fittings in ductile cast iron for optimised solutions for pipeline network and connection pipelines

Cast iron pipes with polyurethane (PUR) lining are perfectly suited for energy-efficient use in Anergy networks.





Left: cross-section of a CEMPUR pipe. Right: cross-section of an ECOPUR pipe.
The PUR lining is predestined for pumping operations where high energy efficiency is of decisive importance.

DUCPUR standard pipe.

The proven, innovative vonRoll PUR lining has unbeatable performance levels:

- suitable for all types of water and wastewater from pH 1 to pH 14
- for soft water and lime-dissolving water
- resistant to antifreeze agents such as ethanol or propylene glycol
- hydraulically smooth, roughness k = 0.0014 mm (according to SVGW guideline W4)
- maximum internal hydraulic cross-section
- minimum pressure losses
- best hydraulic performance

DUCPUR ductile iron pipes with active zinc-aluminium corrosion protection and final coating to EN 545 can be laid in many types of soil.

Soils of different aggression classes require special attention. Under the following conditions it is recommended that ECOPUR or CEMPUR ductile iron pipes with reinforced coating are used:

- contaminated soils (waste, slag, ash, etc.)
- electrical soil resistance < 500 Ω·cm below the water table
- acidic, peaty soils
- stray currents

ECOPUR and CEMPUR full-protection pipes are the solution for every installation situation and they

- give lasting protection against mechanical and chemical attack
- are suitable for all types of soil with any level of aggressiveness
- allow the ballast grain sizes permissible for the pipe coating of 0–63 mm, maximum size 100 mm
- have passive and active corrosion protection and are stable over their entire working life
- are resistant to galvanic corrosion due to stray currents (e.g. by earthing, along railway lines or by mixed soils).

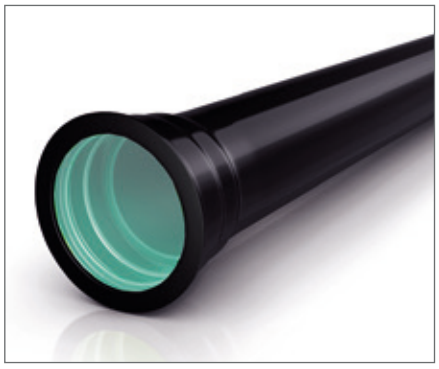
For protection against galvanic corrosion in the area of stray currents, the use of integral ECOPUR electrically insulating full-protection pipes, protected with PUR, is recommended.

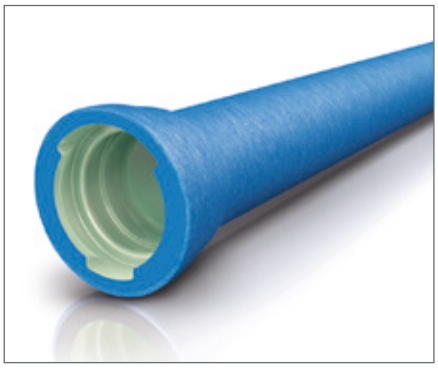
Optimised installation with flexible push-in joints

With full-protection ECOPUR and CEMPUR pipes, the pipeline system is effectively and integrally protected against all underground influences. At the same time, the HYDROTIGHT and BLS® flexible push-in joints guarantee the best possible operational reliability in Anergy networks:

- root resistant push-in joints
- guaranteed tight pipe joints (positive and negative pressure)
- a flexible joint system including thrust protection

When it comes to the installation of pipeline networks in urban environments, because of existing utility lines, space for pipe trenches is often very tight. The ductile iron pipes, often used in Anergy networks as double, feed-and-return





Left: ECOPUR pipe. Right: CEMPUR pipe. ECOPUR and CEMPUR full-protection pipes with reinforced coating.

pipelines, must therefore be provided with multiple fittings and valves.

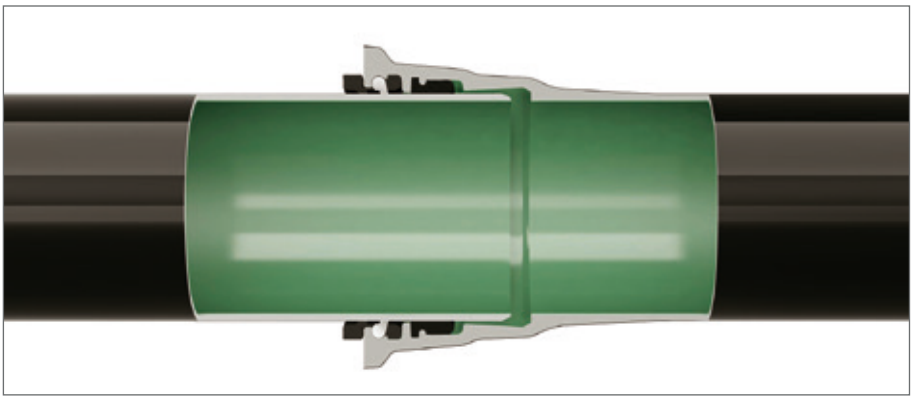
With the flexible HYDROTIGHT and BLS® push-in joints, the installation process is massively accelerated, reliability is extremely high and laying quality is at its best. As proven and secure connection techniques, they offer enormous advantages:

- rapid and flexible assembly
- no need for concrete thrust blocks
- optimum trench widths for double pipelines

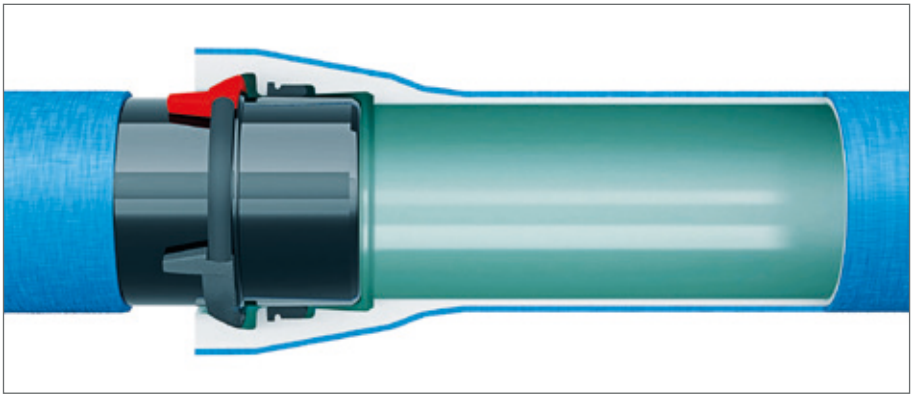
The high cost savings resulting from this for civil engineering and pipe-laying work.

ECOSYS pipe system for thermal utilisation of water and wastewater

The vonRoll ECOSYS pipe system is perfectly matched to the area of application in Anergy networks and meets the highest requirements – both for installation and for long-term operation. The ECOPUR, DUCPUR and CEMPUR type pressure pipes are available from DN 80 to DN 700. Integral full-protection ECOFIT fittings in HYDROTIGHT and BLS® versions, protected with epoxy coating, as well as full-protection fittings complete the range.



ECOPUR system HYDROTIGHT.



CEMPUR system BLS®.

DUCPUR double DN 700 pipeline with feed and return flow.

Examples of implementation of Anergy networks with ductile iron pipes

ARA Anergy network (wastewater purification plant) Werdhölzli, Zurich project

- decoupling of purified wastewater
- double pipeline feed/return: DN 600 ECOPUR
- design for allowable operating pressure of components: 25 bars

Double pipeline at ARA Werdhölzli, Zürich, DN 600, PFA 25 bar.

Anergy network Swisspeak Resorts, Zinal project

- nominal size of pressure pipeline: DN 250 ECOPUR
- pipeline length (single pipe system): 200 m
- max. flow rate: 150 m^3/h
- operating pressure: 3 bars

ECOPUR DN 250 with house connection, DN 100 to the heat exchanger.

Anergy network CAD LA TOUR-DE-PEILZ, Lake Geneva project

- nominal sizes of pipeline network: DN 200 to DN 700 DUCPUR/ECOPUR
- network length (double pipeline): 15 km (final completion)
- volume of water from the lake: 3,600 m^3/h
- connected output: 18,500 kW
- energy produced: approx. 35,000,000 kWh/year
- equivalent energy volume in fuel oil: approx. 3,745,000 l/year
- corresponding to reduction of CO_2: approx. 10,000 t/year

DUCPUR double DN 700 pipeline in the shaft, pulling into the micro-tunnel.

Keywords

Anergy networks, final energy consumption, heat exchanger, cast iron pipes with polyurethane (PUR) lining, HYDROTIGHT and BLS® push-in joints, heat pumps

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Matthias Müller

New generation of resilient seated gate valves

INFINITY with weld-in pipe ends in PE

The INFINITY gate valve design from ERHARD with the usual flange connection to EN 1092-2 [1] has now been supplemented in the product range by a version with PE welding ends. Depending on the pressure stage, the resilient seated gate valve according to EN 1074 [2] has HDPE ends to SDR 17 (PN 10) or to SDR 11 (PN 16) applied on both sides.

The weld-in pipe ends in HDPE 100, coloured blue, meet the requirements of DIN 8074 [3] and are suitable for welding with HDPE pipes and fittings according to melt flow index group MFI 005 and 010 in accordance with DVS guideline DVS 2207 [4].

The INFINITY gate valve with PE ends benefits from the DIN-DVGW type test certificate for drinking water. It is available for the nominal size range DN 40 to DN 300, in pressure stages PN 10 and PN 16.

Properties and advantages at a glance

The gate valve has the following properties and features:

- Firmly integrated, torsion-proof PE pipe ends. The PE pipe is pressed onto the cast ends of the body which are correspondingly provided with claws and/or teeth. Two O-rings set into grooves also ensure the tightness of the connection. The press-socket positioned next to this secures the connection, which is finally protected against corrosion and damage during installation by a shrink sleeve.
- The pipe ends are suitable for two welds.
- Weldable using electrofusion sockets or by butt welding.
- The use of PE standard pipes results in uniform pipe ends (drinking water approval).
- PE pipe colours and classes matched to the operating medium (drinking water in blue or black with blue stripes).
- Medium-free spindle seal.
- Patented bayonet locking system in the bonnet mounting with continuous coating (avoids corrosion problems).
- The wear-resistant single-piece spindle with rolled thread prevents deposits.
- Easy operation with the composite sliding skate integrated into the wedge guide.
- The compact cap without water retention areas reduces risk of bacterial growth.

Enamelled Infinity gate valve.

Applications for the gate valve

This design of gate valve with PE welding ends is usually installed underground. Consequently, the standard actuation version is with a square spindle and hence it is equipped for the attachment of an extension stem. Optionally, the gate valve can also be equipped for the attachment of an extension stem according to DVGW worksheet GW 336 [5] (with adapter disk and coupling sleeve).

Materials and dimensions

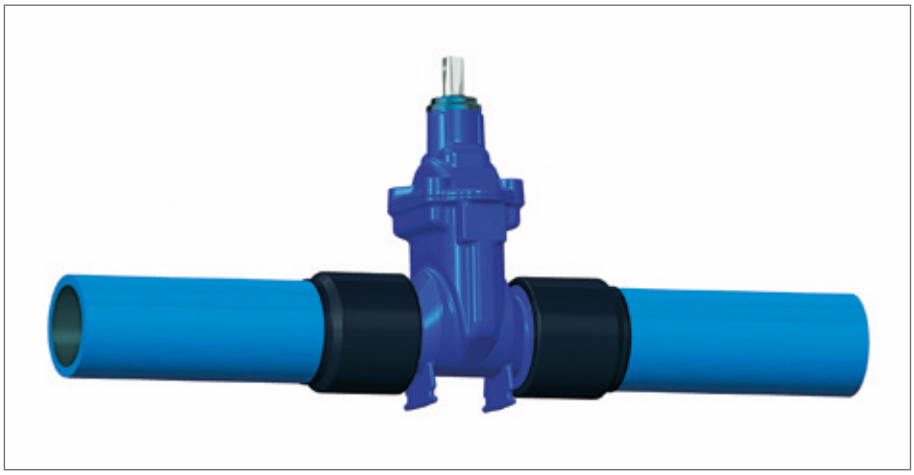
Materials (standard)

- Body, bonnet and wedge: spheroidal graphite cast iron EN-GJS-500-7 (EN-JS 1050)
- Rubber-coating of the gate and O-ring: EPDM, KTW drinking water guideline [6], DVGW W 270 for drinking water [7]
- Spindle: ferritic Cr steel 1.4021
- Spindle nut: brass 2.0402 (UBA)
- Connecting bolts: A4, countersunk and sealed
- Pipe sockets: HDPE 100, blue or black-blue for drinking water
- Press-socket: steel, protected with a shrink sleeve

Coating, choice of two proven corrosion protection systems

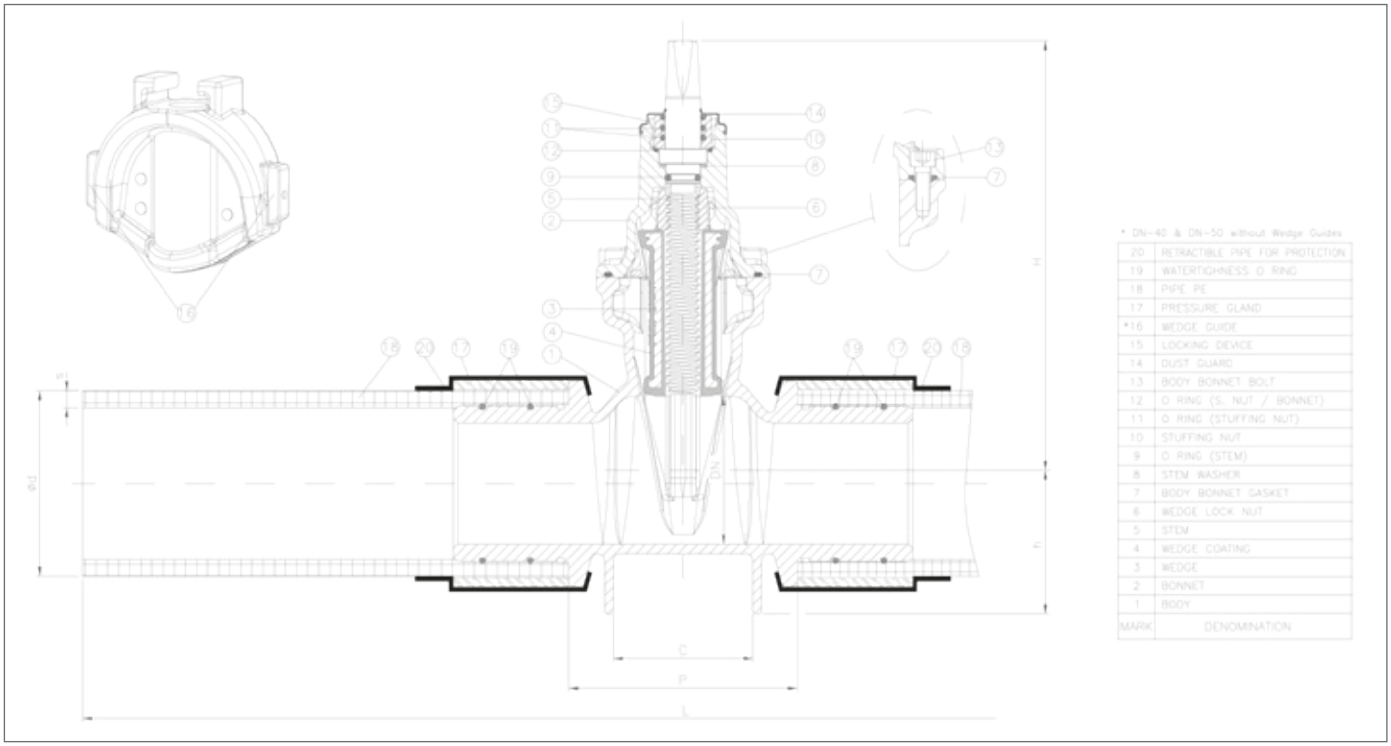
Internal and external, seamless and pore-free epoxy resin coating, coating thickness min. 250 µm to GSK guideline [8] (or internal and external, seamless enamelling) to EN ISO 11177 [9]. The advantages of enamelling are e.g.:

- It is bonded with the casting surface and so protected from underrosting.
- Extremely smooth surface for hygienically problem-free conditions (no depositing of mineral or organic constituents, incrustations).
- Good resistance, even in the presence of abrasive media.
- Underground installation: suitable even for soil class III (DVGW GW 9 worksheet) [10].



Schematic diagram: Infinity gate valve with weld-in pipe ends and connected pipelines.

Components of the Infinity gate valve: spindle, spindle nut, wedge.



MARK	DENOMINATION
20	RETRACTIBLE PIPE FOR PROTECTION
19	WATERTIGHNESS O RING
18	PIPE PE
17	PRESSURE GLAND
*16	WEDGE GUIDE
15	LOCKING DEVICE
14	DUST GUARD
13	BODY BONNET BOLT
12	O RING (S. NUT / BONNET)
11	O RING (STUFFING NUT)
10	STUFFING NUT
9	O RING (STEM)
8	STEM WASHER
7	BODY BONNET GASKET
6	WEDGE LOCK NUT
5	STEM
4	WEDGE COATING
3	WEDGE
2	BONNET
1	BODY

* DN=40 & DN=50 without Wedge Guides

For dimensions and weights of the INFINITY gate valve with PE welding ends: see table for values.

Operating temperatures
Allowable operating temperature: 20 °C (SDR 17 PN 10, SDR 11 PN 16). If used with higher temperatures, the pressures allowable for this in accordance with DIN 8074 [3] are to be observed.

Dimensions, weight
Dimensions and weights can be taken from the illustration above and the table.

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[3] DIN 8074:2011-12
Polyethylen (PE) – pipes PE 80, PE 100 – Dimensions.

[4] DVS guideline DVS 2207-1
Heated element butt welding of pipes and piping parts with high wall thicknesses or diameters made of PE.

[5] DVGW GW 336-1:2010-09
Underground installation fittings – Part 1: Standardisation of the interfaces between buried valves and extension stems.

Dimensions and areas of application for the INFINITY gate valve with PE welding ends.

Pipe wall thickness s [mm]	Overall length L [mm]	P [mm]	C [mm]	Overall height H [mm]	Foot height h [mm]	Square spindle [mm]	Spindle revolutions revs/stroke	Approx. weight excl. hand-wheel [kg]
4.6	880	105	64	170	46	14	11.5	6
5.8	880	110	64	185	60	14	14	8
3.8	880	110	64	185	60	14	14	8
6.8	900	120	74	227	68	17	14	11.5
4.5	900	120	74	227	68	17	14	11.5
8.2	900	127	79	250	75	17	17	13
5.4	900	127	79	250	75	17	17	13
10	900	154	82	287	91	19	21.5	15.5
6.6	900	154	94	287	97	19	21.5	15.5
11.4	975	154	94	287	97	19	21.5	15.7
7.4	975	154	94	287	97	19	21.5	15.7
12.7	1,000	170	97	324	105	19	27	22
8.3	1,000	170	97	324	105	19	27	22
14.6	1,100	171	102	368	127	19	32	26.5
9.5	1,100	171	102	368	130	19	32	26.5
16.4	1,100	171	102	368	130	19	32	27
10.7	1,100	171	102	368	130	19	32	27
18.2	1,100	1,100	160	450	162	24	41.5	46
11.9	1,100	1,100	160	450	162	24	41.5	46
20.5	1,100	1,100	160	450	167	24	41.5	46.5
13.4	1,100	1,100	160	450	167	24	41.5	46.5
22.7	1,350	1,350	160	546	12	27	43.5	68
14.8	1,350	1,350	160	546	192	27	43.5	68
28.6	1,350	1,350	160	621	240	27	51	94
18.7	1,350	1,350	160	621	240	27	51	94

[6] Guideline for the hygiene assessment of organic materials in contact with drinking water (KTW guideline): 2016-03.

[7] DVGW W 270:2007-11 Enhancement of microbial growth on materials in contact with drinking water – Testing and assessment.

[8] GSK guidelines: RAL quality marks in accordance with GSK RAL-GZ 662.

[9] EN ISO 11177:2016-10 Vitreous and porcelain enamels – Inside and outside enamelled valves and pressure pipe fittings for untreated and potable water supply – Quality requirements and testing.

[10] DVGW GW 9:2011-05 Evaluation of corrosion likelihood of buried pipelines and vessels in unalloyed and low-alloy ferrous materials in soils.

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Together in the future

Three strong brands under one roof

An interview with **Dipl.-Ing. Stefan Neuhorn**, Managing Director of vonRoll hydro (deutschland) gmbh & co. kg

In recent years, the Swiss company vonRoll hydro ag has focussed and restructured its areas of competence in Germany. As at 1st January 2020 the German sections have now moved even closer together. The three distribution companies – VONROLL, DUKTUS and KEULAHÜTTE – have been brought together as vonRoll hydro (deutschland) gmbh & co. kg.

Editor: Mr Neuhorn, when it comes to restructuring, one always talks about synergy effects. So, what has now been changed and improved in the new structure?

Stefan Neuhorn: Now, you see, we have an almost ideal situation. In fact, we have not brought competitors together, but companies which complement each other in their portfolios, in their products. Instead of three distribution companies we now have one. This means that the ordering and processing procedures are leaner and faster. And we can put entire systems together with products which match each other perfectly within one company.

Editor: So, what was, or what is so interesting for vonRoll in the takeover and restructuring of the companies mentioned?

Stefan Neuhorn: vonRoll hydro has had already long contact and business relations with the AWP, Duktus and Keulahütte companies. We are familiar with the companies, their products, their values. What we have in common is that we place great value on the systems approach with quality components. And the products of these companies supplement the portfolio of vonRoll hydro beautifully in the water and wastewater infrastructure. Our system thus becomes a round one. In the new constellation, we are perfectly positioned for the worldwide development of a systems approach. And all the areas participating profit from this.

Editor: Does that mean that you want to grow to worldwide status?

Stefan Neuhorn: Yes. Let me put it slightly differently: companies exist in order to satisfy the needs and wants of customers. The better they can do that, the better their turnovers are as well. If you have complete and good systems, that's a great advantage. The customer can get everything from a single source. However, there is yet a further argument: Swiss and German companies are known for their quality. The quality concept is very important to us. And quality is a value which all the companies now brought together live for as well. That means that, for us, it is not a question of growth for its own sake, but of the worldwide development of a system approach with innovative, high-quality products and services for the area of water and gas supply as well as wastewater disposal.

Editor: You are already very well positioned in Europe.

Stefan Neuhorn: That's right. In the new constellation, on the one hand we have a good entrée into the German market and on the other hand we can act even more effectively on an international level. Since, a few years ago, the companies which have now come together were on the look-out for partners, this was a stroke of luck for vonRoll hydro. We were able to unite leading European producers. This means that our position with respect to the competition has become considerably stronger. The

brands are all well known in the market and therefore we will also be keeping the brand names.

Editor: How will the international trade squabbles and distortions affect you?

Stefan Neuhorn: We are very optimistic there. The construction industry is flourishing. Civil engineering in fact more than building construction. We also think that there is a major need there worldwide.

Editor: Can you tell us anything else about the vonRoll hydro company?

Stefan Neuhorn: I'd be pleased to. vonRoll hydro (deutschland) gmbh & co. kg belongs to the vonRoll Infratec group, which employs around 1,200 people at 8 production locations in Europe. The water business of the Infratec group is summed up by vonRoll hydro. Overall, wherever there is a need for the safe and economic supply of water and gas or for the disposal of industrial water, products and services from vonRoll hydro come into their own. For example, valves, cast iron pipes, hydrants, metering technology, drainage technology, drain castings, planning and assembly support as well as network monitoring.

Editor: Mr Neuhorn, many thanks for the interview!

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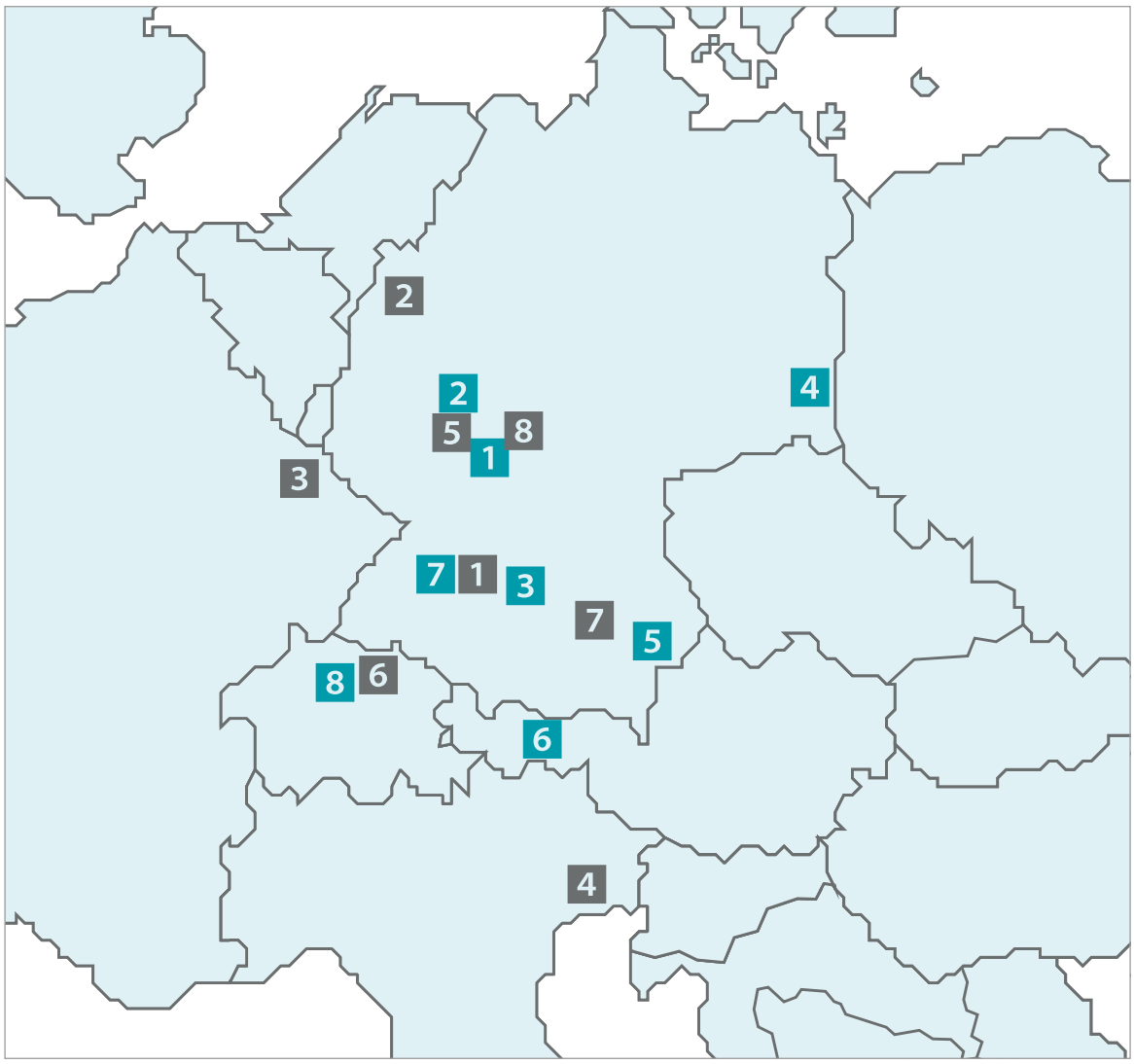

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