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European Association for Ductile Iron Pipe Systems

Fachgemeinschaft Guss-Rohrsysteme

NEWSLETTER

03/2020

Dear Readers,

You have certainly already noticed it via website, trade press and social media: On 1 September, we launched „Guter Grund“, a European initiative that promotes sustainable soil and water protection. This includes our commitment to expanding the supply and sewer networks in our soils with high-quality and safe cast iron pipe systems. After all, we transport our No. 1 foodstuff, drinking water, with it. And there is more than just one good reason for this! This initiative, developed and supported by all member companies, brings all the many good reasons for using ductile cast iron pipe systems for our sensitive habitats to the point.

You all know: Drinking water pipes and sewers, which are built into our soil, are an integral part of our lives. A healthy soil and fresh drinking water are the most important basis of our existence. Protecting both is therefore the most important good reason for us: Our high-quality and safe pipes, valves and fittings made of ductile cast iron can do it! With them we ensure the reliable supply of drinking water to the public and the clean disposal of wastewater.

The material cast iron is extremely durable, extremely safe and not only recyclable but also circulatory. These are the best pre-conditions for using ductile cast iron transport pipelines in our underground infrastructure. Especially in times of climate change and globalisation, it is important to strengthen sustainable and regional solutions. If we use the best product for a secure supply of the best water and produce it regionally, then it is an all-win situation. But, what does it mean to be durable, safe, recyclable and circulatory? There are many good reasons for this on the new website **www.guter-grund.org**, with which the „Guter Grund“ initiative for soil and water protection has now been launched.

I wish you much pleasure and inspiration both with our good reasons and with today’s newsletter.

Christoph Bennerscheidt

Always topical, always informed

The online Newsletter published periodically provides professionals in the field with up-to-date information about interesting European pipeline projects as well as the many and varied activities of EADIPS®/FGR®.

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The right cast iron pipe system for every bedding

Cast iron pipes were the basic stock when it came to the installation of **urban drinking water supplies** 150 years ago. With increasing requirements from users for efficiency and simultaneously increasing chemical and mechanical loads, an innovative foundry industry responded with some sophisticated solutions.

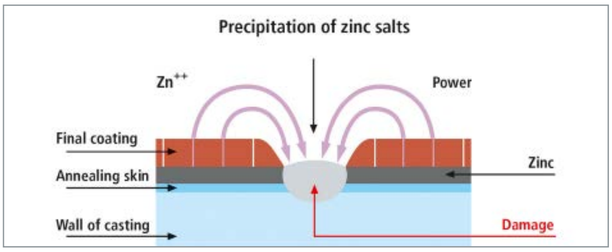
Protection against external chemical influences

Bitumen paints, zinc, zinc-aluminium

In the 1960s 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. 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. The Table shows the **coatings** which have been standardised for **cast iron pipe systems** in Europe.

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.



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

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

Type of external protection for ductile iron pipe systems.

Cement mortar

A fibre-reinforced **cement mortar coating** to EN 15542 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 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.

Soil-Pipe-System

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 with DVGW worksheet GW 9 "Evaluation of **corrosion risks** of buried **pipelines** and vessels in unalloyed and low-alloy ferrous materials in soils". 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 " 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.

System Analysis

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 for **ductile iron pipes**. In the revised version of DIN 30675-2 issued in 1993, 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. DIN 30675-2 was revised for the second time in 2019.

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.

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 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.

Cement mortar coating

In this sector, cement mortar coating to EN 15542 has prevailed, being able to be used in all class I to III soils. 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.

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

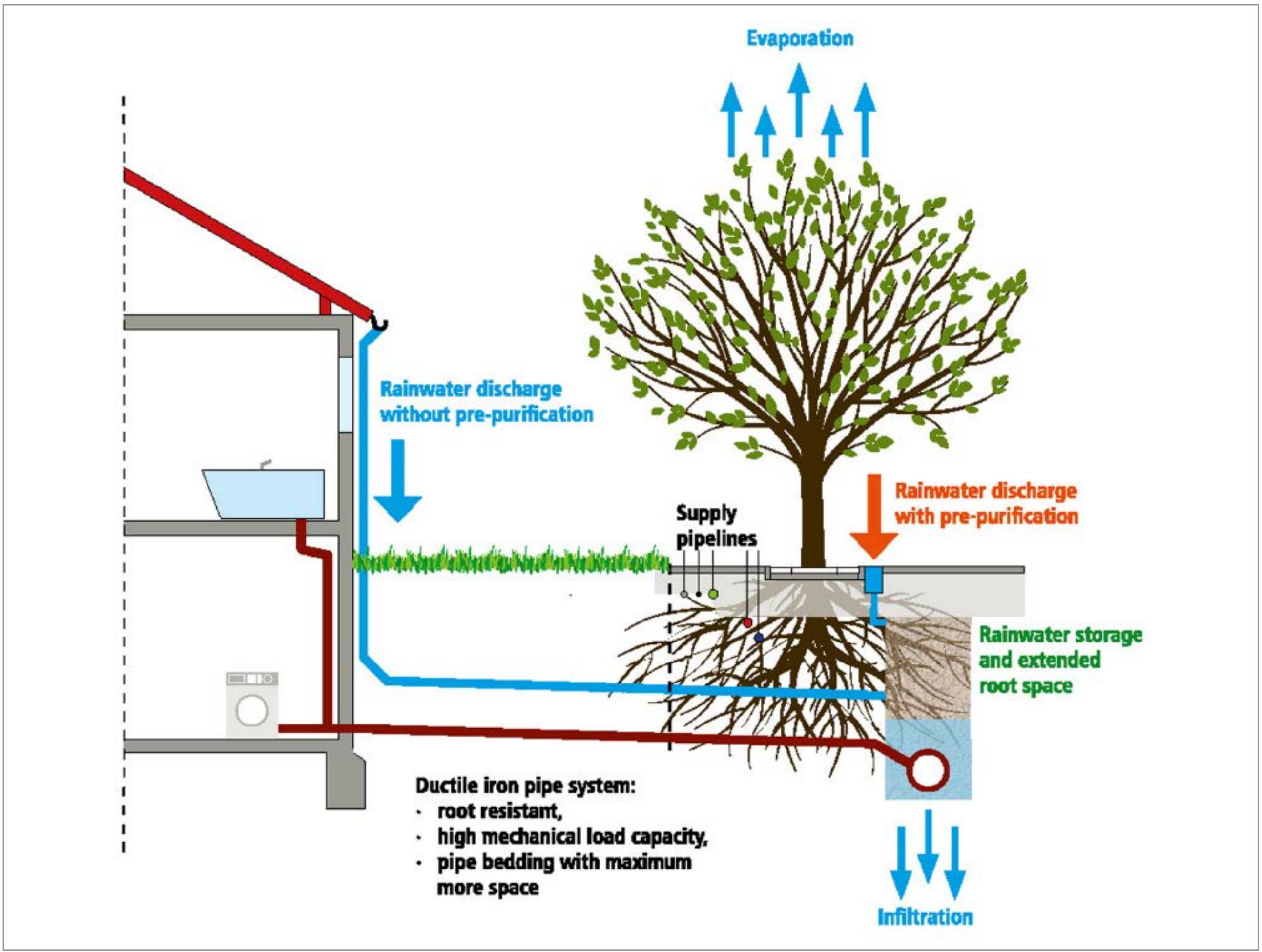
1. The reuse of trench excavation material saves both its transport away from the site and the delivery of bedding sand to the site, which means that additional HGV traffic, including the CO_2 emissions, is avoided. When constructing **water pipelines** in Alpine areas for **turbine pipelines** and **snow-making facilities**, the transport of material is very much restricted and often well-nigh technically impossible. In these cases, the **coating** according to EN 15542 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**:

– Avoidance of flooding by the **intermediate storage of rainwater**.
– **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 technical solutions for the 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**.



The sponge city principle at street level.

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Ductile cast iron pipe as a problem solver

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.

Statkraft AS has built 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; the **Moglicë power station** has now been commissioned in June 2020.

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 %.

A view from the dam down to the emergency spillway.

An assembly team installing a DN 800 pipe.

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 micro-tunnelling 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 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 Statkraft AS 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**.

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**.

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Spectacular pipe mounting in the vertical

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: **the slope is extremely steep** and there was very little space for the installation of the entire plant, which was built on the rock.

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.

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.

Open stream crossing with thrust blocks on both sides.

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

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 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. This also meets the objectives of the **"Energy Strategy 2050"**, which aims to increase local hydropower production. A project which also harmonises with the Energy Strategy of the community of Finhaut. As a "sustainable village" in the Mont Blanc region, Finhaut is working to promote renewable energies.

The project in numbers

- 3 million SF: the budget for constructions
- 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

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