Use of PE 100 supply pipes for the new construction of the BMW car factory in Leipzig

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1. Introduction

In 2000 the BMW Group reached the decision to build a new producing plant in the course of the planned product offensive. The aim was to create the production capacities required for the realignment of the BMW Group.

In addition to Leipzig over 250 other locations from Europe had applied. Then on 18 July 2001 the Leipzig/Halle region was chosen, although foreign locations had advantages when net labour costs were considered. The decisive factors for the choice of location were ultimately the work structures, the possible integration into the BMW production network as well as process control, starting from planning to commencement of full production.

The total amount that the BMW Group will invest in Leipzig is estimated to be 1.3 billion euros by the beginning of series production planned for 2005. A daily capacity of 650 cars will be available after a start-up phase. Once the factory has fully commenced its production, 5,500 people will be employed on the approx. 200 ha area. Furthermore, it is expected that another 4,500 jobs will be created for the region through BMW's choice of location.

Before the construction site was handed over to BMW in spring of 2002, almost 4 million cubic meters of soil had to be moved. This volume corresponds approximately to the load of 200,000 lorries.

The ground-breaking ceremony took place in May 2002. The earth-laid water, gas, and compressed air supply pipes as well as the fire mains were awarded to Arge Strabag/Gergen in autumn 2002, which had engaged LVU GmbH as a pipe-installer for the pipeline part.

2. PE 100 the right choice for all supply pipes

The fire mains for BMW were constructed of the material PE 100 for the first time. This material was also chosen for the other supply lines. All in all, well over 20 km of PE 100 pipelines were laid in the ground during the project. The distribution to the different applications is shown in Table 1.

Gas	Compressed air	Water		Fire-fighting water
d 63 – d 355	d 63 – d 180	d 40 – d 90	d 110 – d 315	d 125 – d 355
approx. 1,500 m	approx. 2,400 m	approx. 500 m	approx. 5,500 m	approx. 15,000 m

Table 1: Supplied pipe quantities according to medium and diameter

The use of PE 100 for gas or drinking water pipes has been state-of-the-art technology for years and offers considerable advantages during installation compared to conventional materials such as cast iron or steel. Frequently the total project costs can be noticeably reduced through these installation advantages. The market shares and growth rates of PE 100 in the gas and water supply sector prove that users are increasingly using this advantage and further benefits of this material. Especially during the construction progress of the many interconnected contract work sections, the flexibility of the PE pipes and their ease of installation was a positive surprise for the client as well.

The pipes and moulded parts were connected by means of thermo-compression butt welding (mainly in the larger dimensions) or through electro fusion welding (small dimensions and connections in cramped spaces).

To optimise construction site workflows, a large number of the parts were already pre-assembled at the factory (Photo 1).

Photo 1: pre-assembled branches for gas pipes and fire mains

Because BMW's experience with compressed air pipes made of PE 100 was also favourable in the past, the entire earth-laid part of the compressed air network was constructed with the Agruair-System made of PE 100 (Photo 2).

Photo 2: Agruair compressed air pipe and fire main (background)

This pipe system was predominantly connected by means of electro fusion welding due to the smaller dimensions to be welded.

The largest part of the supply lines by far was however the pipe system for the fire-fighting water supply. Because BMW planned the installation of a protective sprinkler system in all

production areas, in the central area and in almost all annexes, an extensive pipe line system was required for the provision of fire-fighting water (Photo 3).

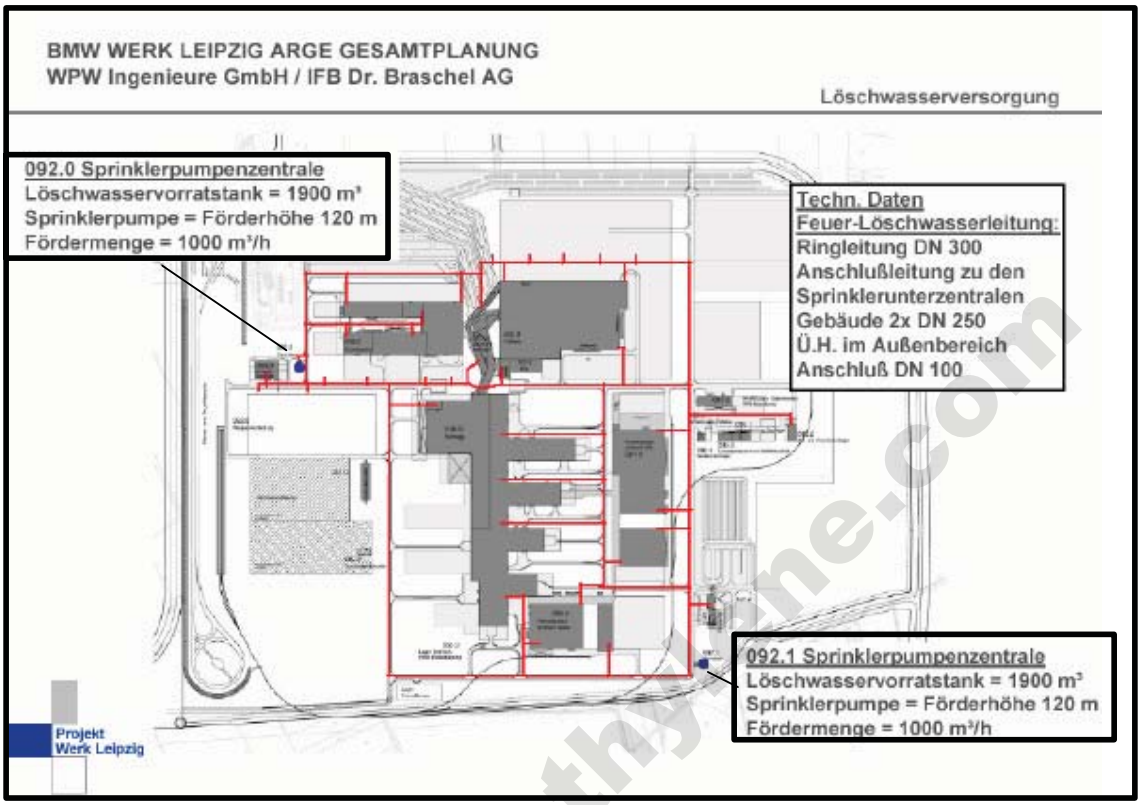

Photo 3: Fire-fighting water supply of the BMW factory in Leipzig

3. Demands on the fire main

The fire main designed by WPW Ingenieure GmbH was required to provide a reliable supply of the sprinkler sub-central rooms over the earth-laid pipe network, which has to be guaranteed even if one of the available sprinkler pump central rooms has to provide the required fire-fighting water via the worst pipe course.

Furthermore it was required that all parts in the area of the fire-extinguishing systems have to be furnished exclusively with FM approval for earth-laid fire mains. This approval requires that the individual parts meet very high standards, which must be confirmed through independent tests on the one hand and proven through continual monitoring tests on the other hand. The basis for this approval is compliance with the FM Class Number 1610 "Pipes & Fittings for Underground Fire Protection Service".

In addition to the known standard tests, the fire insurance company "Factory Mutual" (FM) requires further tests, such as ring stiffness tests, torsion tests on pipes under operating pressure or impact deformation tests on components under double operating pressure.

However, the greatest demands on the pipes and moulded parts are made by the prescribed internal pressure creep rupture tests (Photo 4).

Photo 4: Internal (burst) pressure test at a testing stand in accordance with FM standard 1610

These tests must be carried out in two phases every 8 hours. During the first step the components are pressurised with double operating pressure for 5 minutes. There must not be any leaks or permanent deformations during this phase. Then the pressure is increased to the fourfold operating pressure during the second phase. It must be possible to maintain this pressure for 5 minutes as well. Deformations and small leaks are admissible, but leaks that lead to a pressure drop or failure of the components themselves mean that the test was not passed.

These tests must be carried out on all parts – e.g. also flange joints. Because the inspection effort connected with this is enormous, these tests are carried out to order in normal cases. Parts that were tested in accordance with the approval criteria are specially marked at the factory for these reasons (Photo 5).

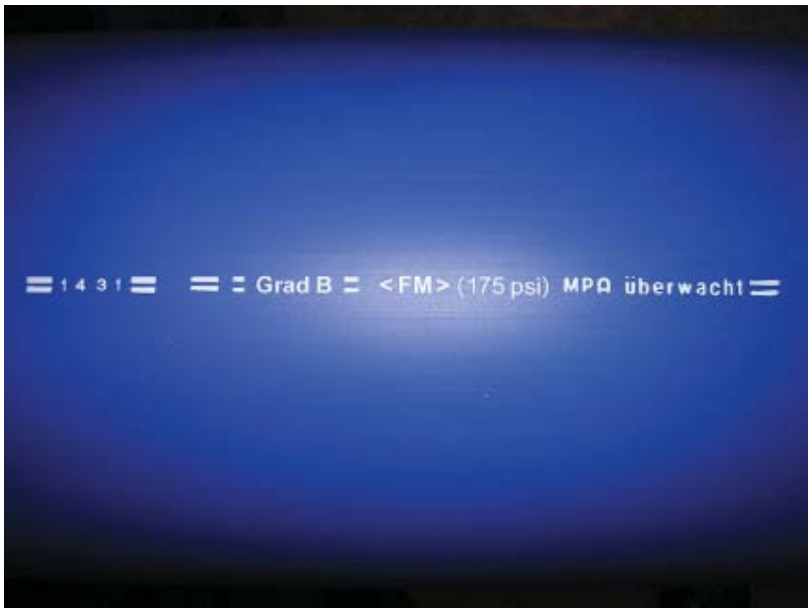

Photo 5: Marking in accordance with FM standard 1610

All pipes and moulded parts supplied for the project were tested not only according to the standards of the fire insurance company but also by lot in accordance with the standards of the Deutsches Institut für Bautechnik (DIBt) (German Institute for Structural Engineering). The drinking water and gas pipes were tested in accordance with the Deutsche Vereinigung des Gas- und Wasserfaches e. V. (DVGW) (The German Technical and Scientific Association for Gas and Water). These tests were documented by the manufacturer in inspection certificates (3.1.B certificate according to EN 10204).

4. Installation of the supply pipes

The installation of the supply pipes was largely completed by spring 2003 (Photos 6 to 9). The moulded parts used in the main pipe were constructed with short weld-on ends due to the dimension. Fittings (cast iron) were connected exactly like the adapters in the sprinkler sub-central room with flange joints.

Photo 6: Parallel connecting pipeline to a sprinkler sub-central room

Photo 7: Branch from the main pipeline (DN 300) to the sprinkler sub-central room (DN 250)

Photo 8: Prepared connection to the sprinkler sub-central room

Photo 9: Fittings being fixed in the fire main and drinking water pipe

When the project was finished, the pipelines were subjected to pressure tests with a testing pressure of PN +5 bar. The fire main was tested with a testing pressure of 21 bar. Except for one leaky flange joint, which was repaired by tightening the bolts, the pressure tests proceeded without any faults.

5. Conclusion

BMW's innovative decision to rely on the advanced material PE 100 for the earth-laid supply pipes was the right choice also in retrospect. Smooth, fast installation, long service life and immense safety reserves are only three of the many advantages which mark out PE 100 pipe systems.

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