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Fountain galleries and clean raw water pipes online

Wells are subject to natural ageing processes, as well as deposits and ochre deposits in pipelines water transportation.

Dhe Berliner Wasserbetriebe (BWB) operate more than 650 wells to supply drinking water. These wells supply water via well galleries and raw water pipes the waterworks.

The majority of wells are subject to natural ageing processes. BWB's many years of operating practice show that iron bacteria play a key role in well ageing. The wells become clogged. Appropriate well treatment measures, the use of alternative lining materials and as few well shut-ins as possible are used in an attempt to slow down the ageing processes. Deposits and ochre deposits in the pipes lead to increased pressure losses. One of the aims of the project funded by the Federal Ministry of Education and Research

Image 1 Vertical wells on the island of Baumwerder supply the raw water for the Tegel waterworks Photo: Andritschke

GEFÖRDERT VOM
Bundesministerium für Bildung und Forschung

The aim of the joint project "Microbial Soiling in Technical Systems" funded by the Federal Ministry of Education and Research (BMBF) is to use innovative cleaning processes such as the pulse rinsing process in practice and to determine the effects /1/. The BWB expects new strategies to the sustainable management of the wells and the network in order to significantly reduce the costs for well and network operation and energy costs. The project thus makes a significant contribution to securing and optimizing the supply of drinking water, taking into account economic and ecological aspects.

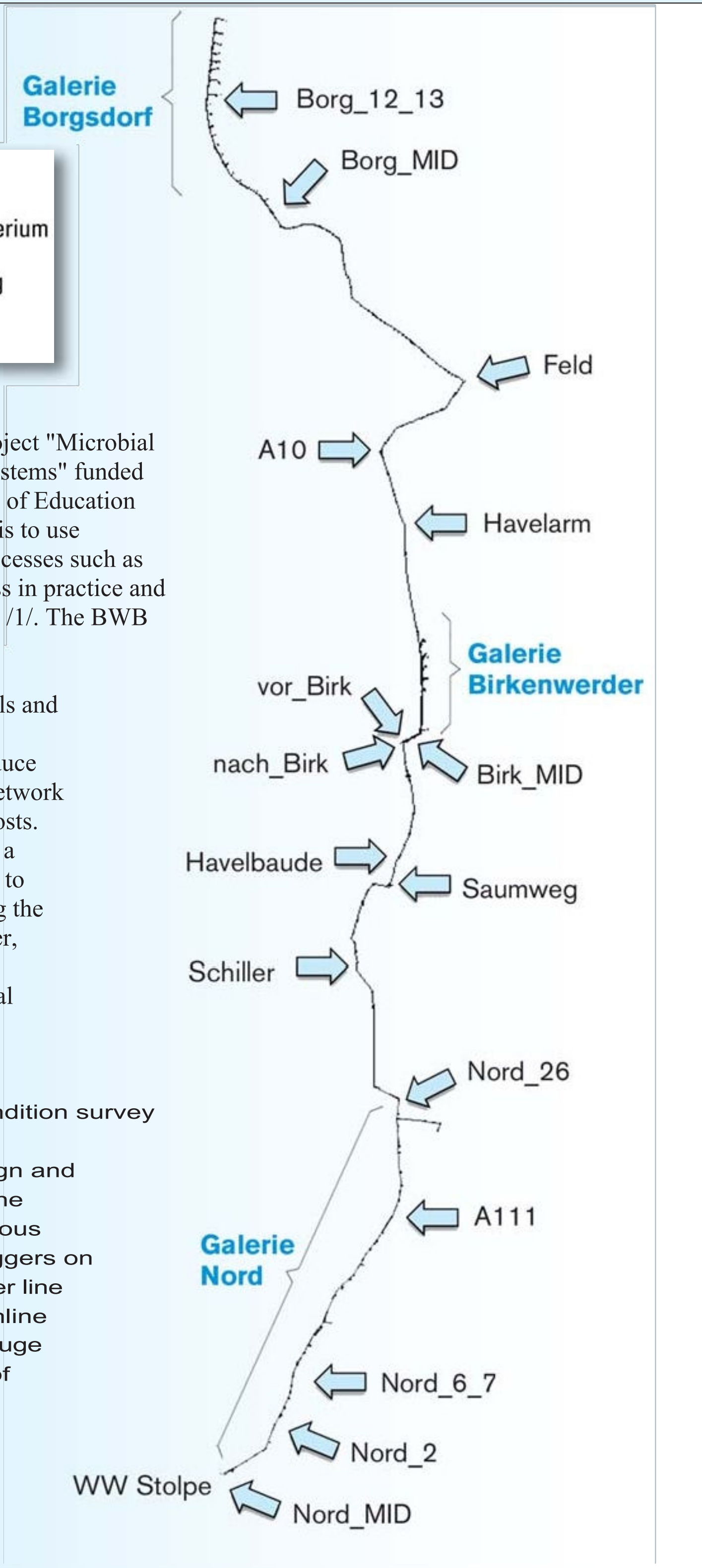

Figure 2 Condition survey during the first campaign and location of the 13 autonomous pressure loggers on the raw water line and the 3 online Pressure gauge at the MID of the galleries

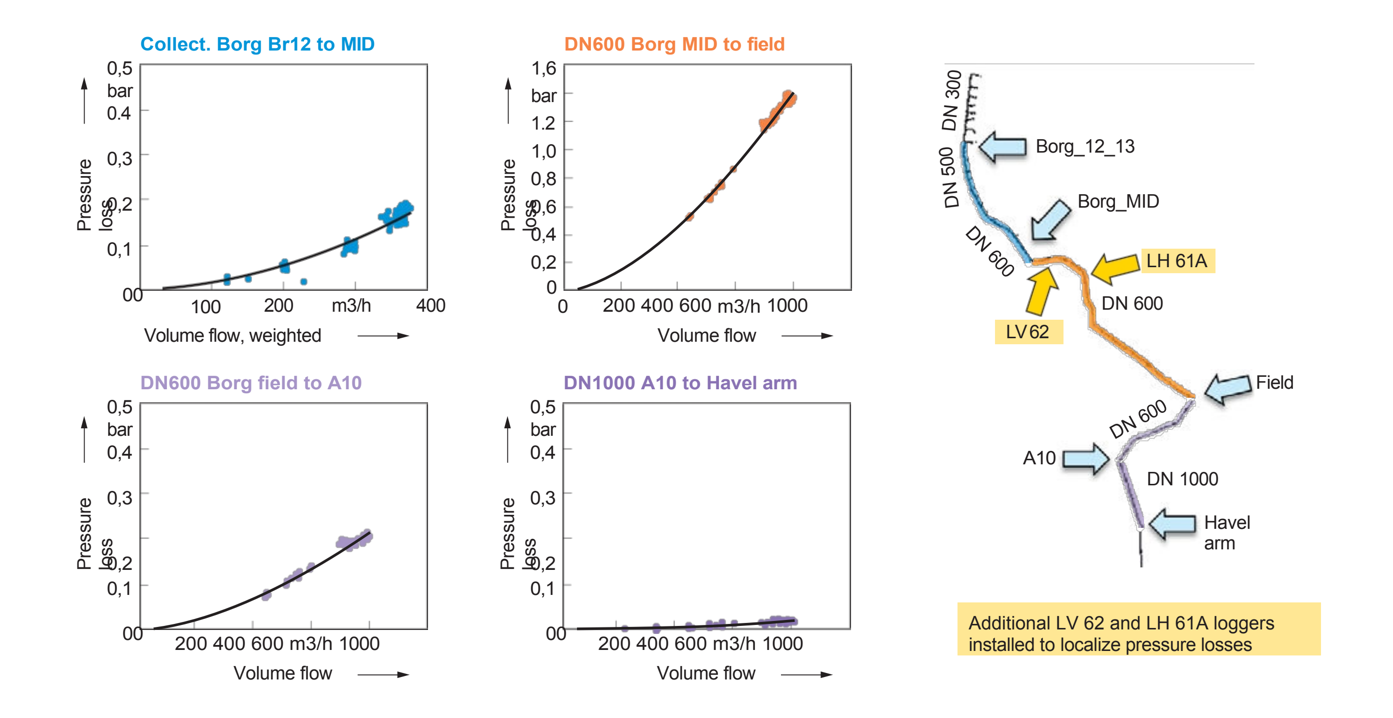

Figure 3 Characteristic curves of the pipeline sections between the Borgsdorf and Birkenwerder galleries, determined in the first campaign

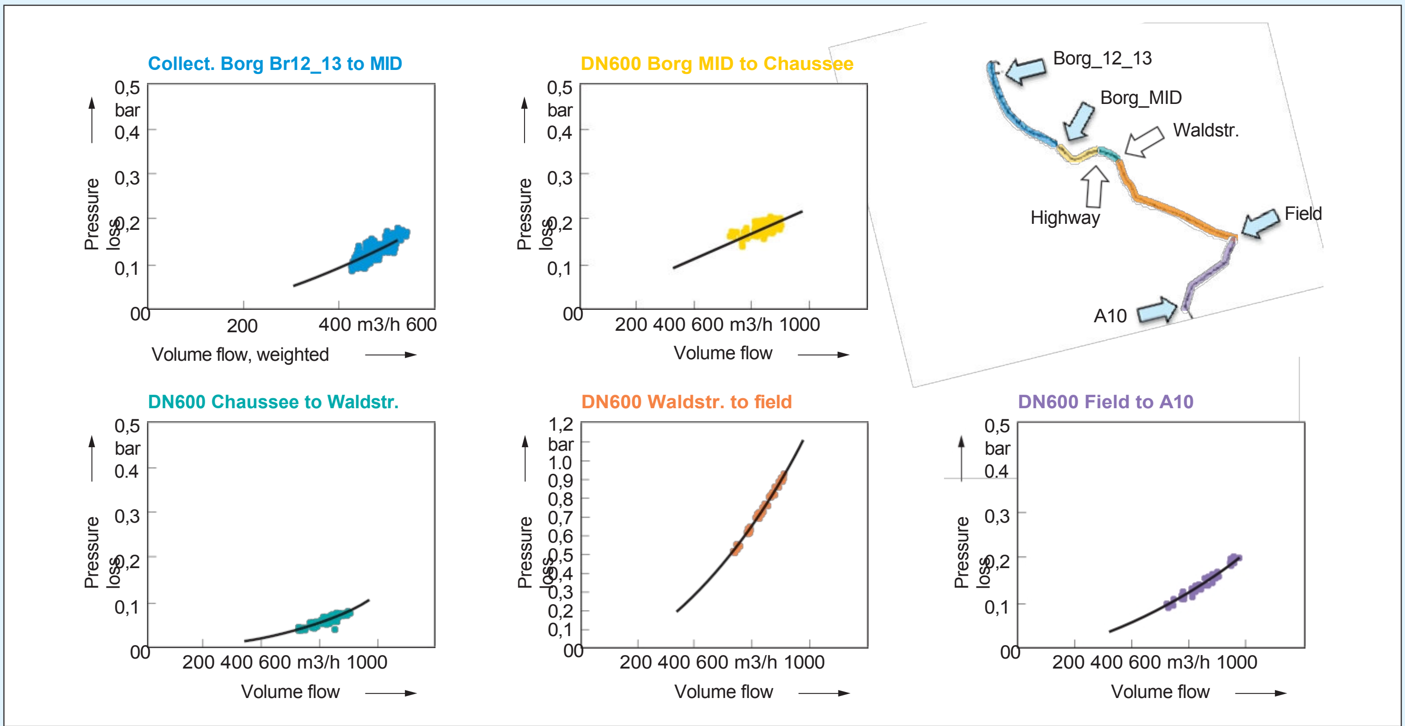

Figure 4 Characteristic curves of the pipeline sections between the Borgsdorf and Birkenwerder galleries, determined in the second campaign

Process engineering or process basis

The cleaning of pipes in the drinking water sector requires the pipes to be taken out of service. This means that no drinking water is available during this measure. This procedure was previously also common when cleaning raw water pipes. The main problem here, however, is the large flushing volumes.

water volumes and their disposal. It therefore made sense to look for alternatives to clean at least some areas online.

During online cleaning, for example of waste water pressure pipes or certain cooling water pipes, the water is cleaned with the water present during water transport. Flushing water from waste water pressure pipes can then be in the sewage treatment plant. Cleaning techniques such as pressurized air flushing in accordance with DWA-A 116-3 /2/ and, increasingly, the impulse flushing method are being used for the online cleaning of wastewater pressure pipes. The advantage of the impulse flushing method is that certain sections defined by feed points can be cleaned specifically and intensively.

Demonstration Tegel-Nord: Raw water pipeline

The question now arose as to whether this technology could be transferred to well galleries and raw water pipelines and what requirements had to be met. To this end, BWB and Hammann investigated various approaches as part of a BMBF research project. BWB provided the raw water pipeline and Hammann the cleaning technology. Joint considerations led to a work program in order to be able to carry out the measure efficiently.

BWB treats between 20 and 24 million cubic meters of raw water per year at the Stolpe waterworks from 4 galleries along the Oberhavel with a total of 91 wells. As the operating time increases, so does the performance of the pumps and the pipes.

Figure 5 Compressed air and nitrogen feed into the well line controlled by a Comprex unit Photo: Hammann GmbH

pipeline. While the pumps with reduced performance are being replaced with new ones, the assessment of the raw water pipeline and well galleries was previously not possible or only possible to a limited extent. This requires a condition assessment not only of the entire pipeline, but also of individual pipeline sections.

Condition survey of the pipe sections

First of all, the metrological requirements for the requirements must be created. Then the pipe characteristics of the individual pipe sections can be determined by means of performance runs. This means that not only the current

The condition of the pipes after cleaning and the improvement in performance can also be seen. The length of the three galleries and pipe sections, which were measured during the first campaign with 3 online pressure gauges on the EMF and with 13 autonomous pressure loggers are shown in Figure 2 (p. 15).

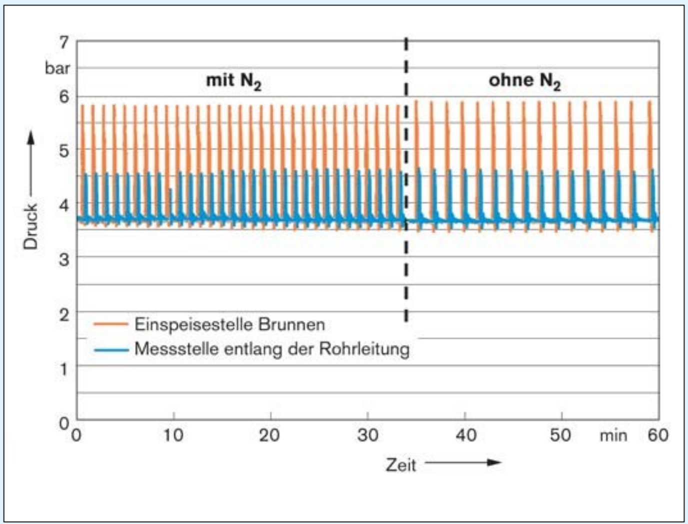

Figure 6
Pressure curve with nitrogen addition to temporarily increase the performance of the Comprex-procedure and without Nitrogen addition

The characteristic curves determined on the pipeline sections between the Borgsdorf and Birkenwerder well galleries can be seen in Fig. 3 (p. 16). Here, a very high pressure loss can be seen in the red DN 600 pipeline section. This is the reason for investigating this section further. The other sections show moderate to no pressure losses.

The next step was to find the cause of the high pressure losses in the approximately 1,300 m long DN 600 section. For this purpose, additional pressure loggers were installed on both the main pipes and the well connection pipes in the second campaign. A comparison of the measured pressure losses with calculated target values was used to estimate possible energy savings after the improvement.

Fig. 4 (p. 16) shows the characteristic curves based on the measurements on the 5 pressure loggers. The installation position can be seen from the sketch. A striking feature is the 925 m long section marked in red, which only had a determined nominal width of DN 412 instead of DN 600 hydraulically.

From inspections of the pipeline at selected points, it was known that thick deposits had formed during the period of operation.

Comprex cleaning for refurbishment of raw water pipes

The Comprex impulse flushing process has often been used by BWB to clean large raw water pipes. Certain pipe sections were taken out of operation during the cleaning process /3, 4/. The rinsing water was either fed into sedimentation tanks via the waterworks or disposed of via infiltration areas. This procedure was not possible for the pipe sections on the main pipeline described here.

and the fountain galleries were not possible. Innovative solutions were required.

BWB and Hammann are involved in the BMBF joint project "Microbial contamination in technical systems". One result of the research work is a new way of operating the Comprex cleaning system in order to achieve a higher cleaning effect with less water. This led to the idea of treating the rinsing water produced in a time window during cleaning via the waterworks filters instead of disposing of it. The substances in the deposits in the raw water pipe originate from the turbidity and the raw water itself. They are therefore not

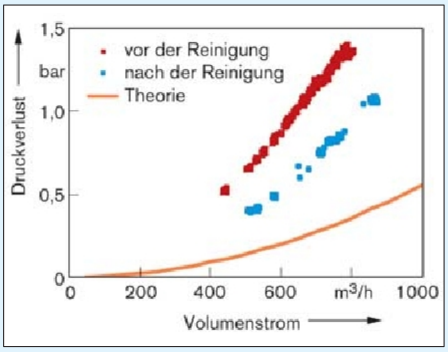

Figure 7 Comparison of the pipe characteristics before and after

Foreign matter that interferes with treatment in the waterworks. To clean pipes larger than DN 400, two powerful Comprex units are always required to provide enough compressed air to form air and water blocks at short intervals. Two innovative ideas were used for the first time during the two-week project. On the one hand, cylinder batteries with nitrogen replaced the second Comprex unit in order to keep the costs for personnel and technology to a minimum. On the other hand, a new control unit enabled the now patent-pending modulation of the pulse output. As part of the project, the working gas was fed into 20 wells and one hydrant on the pipeline (Fig. 5, p. 17).

From the research activities in the BMBF joint project, it is also known that the pressure curve in the cleaning section provides information about the efficiency of the cleaning. This knowledge helped to optimize the setting parameters. For example, it was shown that throttling the volume flow by switching off some pumps increased the effectiveness of the cleaning process. Monitoring with the measuring device developed as part of the BMBF joint project provided the necessary information. The selected settings resulted in air and water blocks between 30 m and 50 m in length. The effect of the additional nitrogen addition is shown in Figure 6.

The nitrogen was fed from the cylinder battery via a pressure reducer directly into the supply tank of the Comprex unit, which controlled the pressure pulses (Fig. 5, p. 17). It was shown that nitrogen from a cylinder battery is available more quickly than compressed air from a compressor of a Comprex unit. In mathematical terms, the nitrogen support even made it possible to increase the output of a Comprex unit by a factor of 2.5. The nitrogen requirement per well connection line amounted to

Figure 8 Effectiveness of Comprex cleaning on DN 200 well connection pipes Photo: BWB

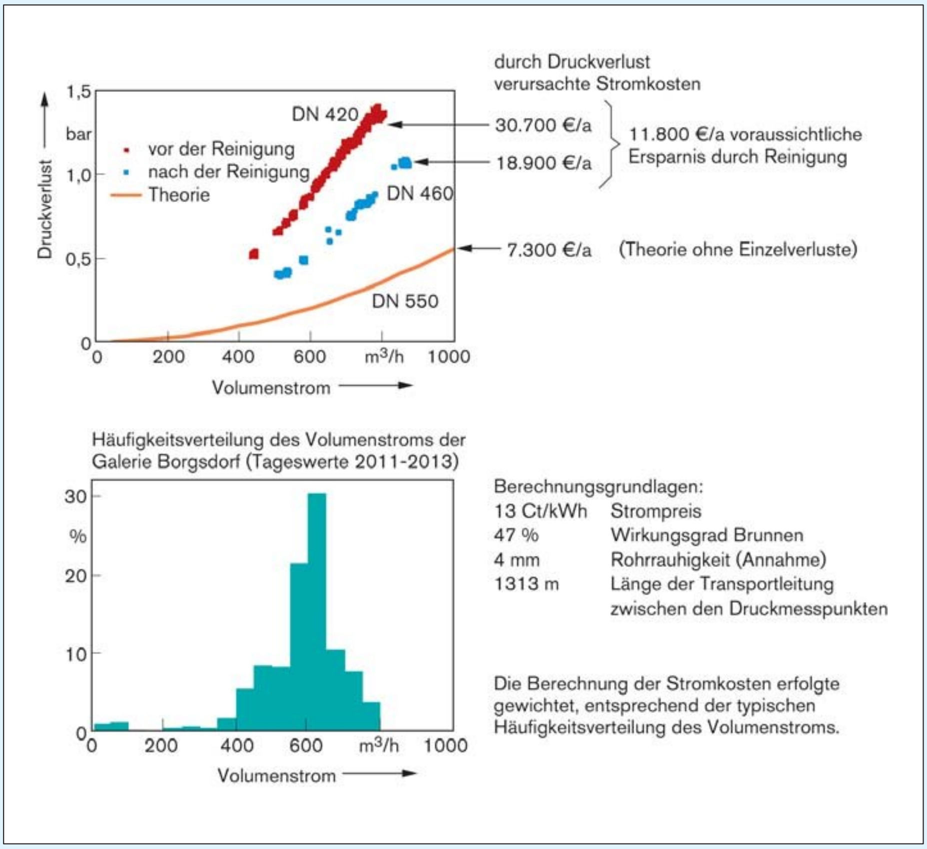

Figure 9 Estimation of energy savings through Comprex cleaning

This required about two batteries with 12 flaps each. One battery was sufficient for around 30 minutes to clean short pipe sections such as well connection pipes (Fig. 6, p. 18). Another Comprex unit was added on two days to clean the DN 600 main line. The nitrogen support increased the performance of the two Comprex units as much as if 5 Comprex units were in use.

Results

The measure showed that Comprex cleaning is also possible online with reduced operation of raw water pipes during periods of low demand. The new findings could be put into practice. The performance of the pipes could be increased. Figure 7 (p. 18) shows the theoretical pipeline characteristics as well as the pipeline values determined during performance runs before and after cleaning.
Inspection of the pipe section after Comprex cleaning also showed a clear improvement, especially on the connecting pipes to the wells (Fig. 8, p. 18).
The comparison of the pipe characteristics (Fig. 7, p. 18) leads to the assumption that other factors besides deposits cause pressure losses. In a further measure, the function of the fittings is to be checked. Based on these piping characteristics and the frequency distribution of the volume flow in the pipe, the energy savings already realized today as a result of the cleaning measure can be estimated (Fig. 9). According to this, the costs for Comprex cleaning will have been amortized after two years at the latest.

Acknowledgments

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LITE RATU R

/1/ BMBF joint project "Microbial ochre formation in technical systems": http://www.anti-ocker.de
/2/ DWA-A 116-3 Special drainage methods - Part 3: Compressed air flushed wastewater transport pipes (May 2013)
/3/ http://www.hammann-gmbh.de/de/269/applications/municipal-networks/rawwater pipes/dn-1000-ww-stolpe/ part-1.html
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