g.: Hammann GmbH

Fig. 1 - Water suction/irrigation unit connected to the hydrant

Preventive mesh maintenance - two methods for different areas of application

In addition to flushing itself, water suction flushing (Fig. 1) also enables the condition of pipe sections in the drinking water distribution system to be assessed. Critical areas in the network can be identified in particular using hot spot analysis. These can then be thoroughly cleaned using the pulse flushing method (Fig. 2). Drinking water networks require regular maintenance in order to ensure the perfect quality of the drinking water for the consumer.

The patented Comprex impulse flushing process from Hammann GmbH is used both for the maintenance cleaning of existing networks and for powerful basic cleaning in the event of contamination. Many water suppliers have been using this process for years to maintain their pipelines, ensuring that thousands of households and their residents are supplied with clean drinking water.

Fig. 2 - Use of the pulse flushing process with compressed air dosing (top) and discharge point (bottom)

Safe drinking water supply thanks to clean pipes

Drinking water networks consist of pipes made of various materials - mainly in nominal diameters from DN 80 to DN 300. In many supply areas today, there are still cast iron pipes from before 1970. The cast iron pipes installed at that time did not have a cement mortar lining. And the Drinking Water Ordinance with limit values for corrosion-relevant parameters did not exist at that time either. This is why these old pipes are prone to internal corrosion and deposits of corrosion products when exposed to water containing limescale.

This can affect both safety and the security of supply. For example, pipes with a constricted cross-section may not supply enough water in the event of a fire. If there is a high demand for water, swirling fine particles, so-called loose deposits, can also lead to turbidity. It is therefore necessary to clean the pipes in good time in order to be able to supply customers with flawless drinking water at all times and to guarantee the supply.

Clean pipes are essential and a prerequisite for the high operational safety of drinking water supplies. In addition to hygiene and safety aspects, cleaning

» The data analysis allows so-called hotspots to be identified. At these sections, a large, sometimes long-lasting, flow of water occurs during flushing. Turbidity. This means that water suction flushing alone is not sufficient to restore the relevant sections to a clean condition. «

These problems are less common with lime-depositing water and especially when phosphate is added as a corrosion inhibitor. Nevertheless, deposits form in the pipe network. In certain cases, these can affect both the drinking water supply

and the water quality.

measures are economically relevant, especially when considering the costs and benefits. After all, regularly cleaned pipes have a longer service life. The savings from no longer having to replace parts

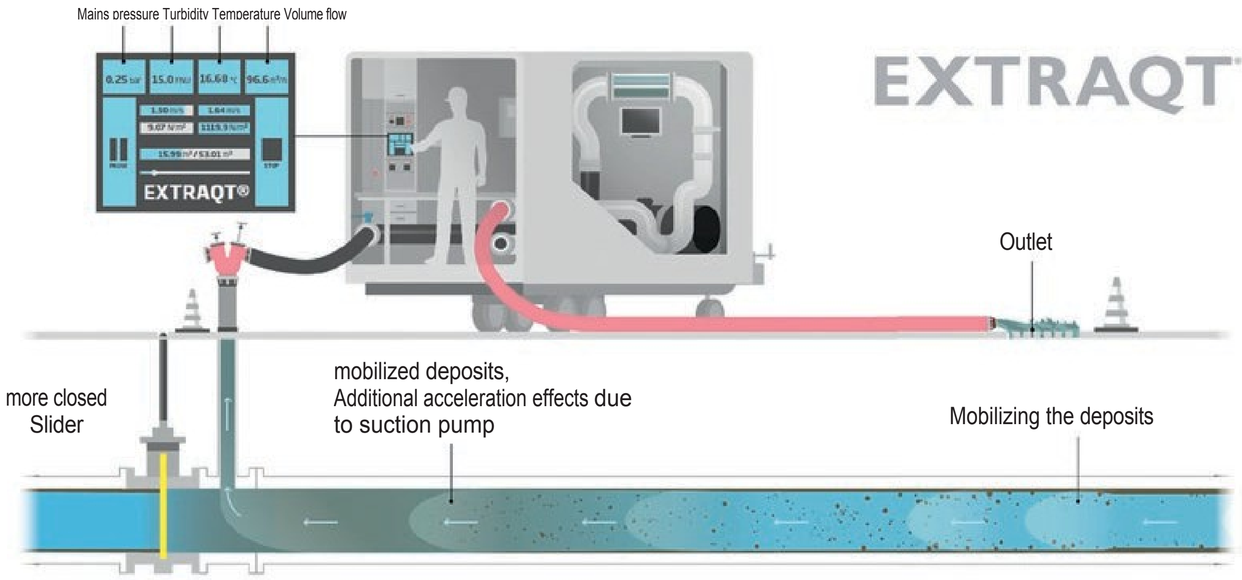

Fig. 3 - Diagram of the water suction flush with integrated data acquisition

of the pipe system compensates for the costs of cleaning - even over many years. The Comprex process maintains the actual condition of even heavily encrusted pipes. It makes it possible to only have to replace pipes due to age and due to increased malfunctions such as burst pipes and insufficient water pressure.

Flexible cleaning process

The mobile Comprex technology can be used specifically on individual pipe sections (Fig. 2). Changes in nominal diameter are also no problem. In contrast to pigging, the air and water blocks adapt to the geometry of the pipe and cannot get stuck. The daily performance of Comprex cleaning depends primarily on the nominal diameter and degree of soiling. It takes longer for basic cleaning of very constricted pipes than for regular maintenance cleaning. For old cast iron pipes, it is around 500 to 700 m/day. The results of the cleaning show that the targeted removal of deposits improves hydraulic conditions, increases the flow rate and maintains the wall-free water supply through clean pipes.

Combination of pipe network cleaning and valve inspection

The process combination of pipe network cleaning and valve inspection, if necessary with valve upgrading (Comprex netcare), restores pipe networks to a hygienic and hydraulic condition.

Fig. 4 - Water suction flush in use

condition and extends the service life of the shut-off valves. This significantly reduces the number of gate valves that need to be replaced [1, 2].

Most gate valves are open during mains operation. Deposits can build up in the valve body and impair its functionality, causing the valves to close inadequately or not at all. DVGW worksheet W 400-3 describes the valve inspection in supplement B1. However, the actual shut-off function cannot be determined in this way. It can only be checked when the pipeline is out of operation, for example before the pipe network is cleaned.

Systematic approach

The gate valves that limit the pipe section to be cleaned must be closed. The water outlet at the standpipe of the outlet valve indicates whether all actuated valves are closing tightly. Valves that do not close or close poorly are detected and marked. These valves are specifically trained by opening and closing them several times, with the release force of the impulse flushing process providing support if necessary. Experience has shown that between 50 and 70 percent of gate valves can be trained in this way and no longer need to be replaced. As the powerful cleaning takes place after and during the valve repair, it is ensured that all substances that have been loosened and mobilized from the valves are reliably removed from the pipe network.

There are other advantages to combining pipe network cleaning and valve inspection. For example, this measure helps to keep the planning and maintenance documents up to date. In addition, it allows the service life of the pipes, including the fittings, to be extended. Today, DIN EN 805 specifies a planned service life of 50 years for pipelines. This means an annual renewal rate of 2 percent. However, this is hardly possible nowadays because in many places there is neither the budget for renewal nor the possibility of new construction. On the other hand, failure-related renewal in the event of damage such as burst pipes is cost-intensive and risky for reasons of supply security. It is difficult to continue with the same water costs. Consequently, the only remaining option is condition-based maintenance, which is based on the determined actual condition and the development trends in comparison to a defined target condition.

Some municipal utilities are planning to optimize the condition of their distribution networks over the next few years. Various methods are available for pipes on the one hand and shut-off valves and hydrants on the other. Gate valves can be characterized by their actuating torque and stroke. For open hydrants, the maximum volume flow is decisive. The condition of pipe sections, on the other hand, can be determined using characteristic curves and features before and after cleaning. Recently, the combination of water-suction flushing for hotspot analysis with targeted, powerful air-water impulse flushing (impulse flushing method) on critical pipe sections has proven to be advantageous.

Combination of water-suction flushing and impulse flushing method

The new edition of DVGW Code of Practice W 291 describes various cleaning methods, including water suction flushing and air/water pulse flushing. In addition

Fig. 5 - Turbidity during water suction flushing as an indicator of hotspots in the drinking water network

It also provides information on condition-based flushing with the aim of defining flushing intervals for practical flushing districts. Explanations can be found in the informative appendix of the worksheet.

The ExtraQt process offered by Hammann uses water suction flushing to remove loose deposits on the one hand and to characterize the condition of the flushing sections based on turbidity on the other (Fig. 3 to 5). The data comparison before, directly after flushing and after different operating durations makes it possible to evaluate the respective condition and recognize trends. The data evaluation allows so-called hotspots to be identified. At these sections

A large, sometimes long-lasting turbidity occurs during flushing. This means that water-suction flushing alone is not sufficient to restore the relevant sections to a clean condition. This is where the more thorough air-water pulse rinsing - the Comprex process - can help.

The corresponding flushing sections can be determined and documented using GPS data from hydrants used to flush the pipes. The linking of these Data with turbidity data from flushing provides information on the extent of loose deposits in these pipe sections. They are used, for example, to display and document the condition of pipe sections in the form of a traffic light (Table 1). Based on this documentation, maintenance cycles for flushing these pipe sections and for inspecting the corresponding valves can be optimized.

Table 1 - Practical example of an analysis of hotspots (customer: Stadtwerke Musterstadt GmbH & Co. KG)

Date	Flushing location	Range	Withdrawal	Nominal diameter	Net length	Withdrawal factor	Clouding end	Score	Recommendation
10.02.20	Sample city	Forest settlement	H1001 Main road	150	2000	2,777	1,0	4	Need for action, z. e.g. repeat rinsing
10.02.20	Sample city	Forest settlement	H1002 Main road	200	2330	1,921	2,0	2	Follow-up rinse after control interval
10.02.20	Sample city	Forest settlement	H1003 Bahnhofstraße	100	1555	3,203	0,0	4	Need for action, z. e.g. repeat rinsing
11.02.20	Sample city	Forest settlement	H1004 Bahnhofstraße	100	1460	12,040	1,0	8	Urgent need for action, z. e.g. Comprex cleaning
11.02.20	Sample city	Forest settlement	H1005 Bahnhofstraße	150	1150	5,691	2,8	5	Need for action, z. e.g. repeat rinsing
11.02.20	Sample city	Forest settlement	H1006 Bahnhofstraße	100	1890	7,416	0,0	5	Need for action, z. e.g. repeat rinsing
12.02.20	Sample city	Forest settlement	H1007 Bahnhofstraße	100	1145	7,073	0,6	5	Need for action, z. e.g. repeat rinsing
12.02.20	Sample city	Forest settlement	H1008 School route	100	1000	4,425	0,9	4	Need for action, z. e.g. repeat rinsing
12.02.20	Sample city	Forest settlement	H1009 School route	100	1750	6,275	2,9	5	Need for action, z. e.g. repeat rinsing
12.02.20	Sample city	Forest settlement	H1010 School route	150	1500	1,753	3,0	4	Need for action, z. e.g. repeat rinsing
12.02.20	Sample city	Forest settlement	H1011 School route	100	1845	10,357	3,0	8	Urgent need for action, z. e.g. Comprex cleaning
13.02.20	Sample city	Forest settlement	H1012 School route	150	2100	6,042	4,3	7	Need for action, z. e.g. repeat rinsing
13.02.20	Sample city	Seaside town	H1013 Drosselgasse	200	2205	1,507	3,8	4	Need for action, z. e.g. repeat rinsing
14.02.20	Sample city	Seaside town	H1014 Drosselgasse	200	865	7,038	7,3	10	Urgent need for action, z. e.g. Comprex cleaning
14.02.20	Sample city	Seaside town	H1015 Drosselgasse	150	2275	5,827	2,8	5	Need for action, z. e.g. repeat rinsing
14.02.20	Sample city	Seaside town	H1016 Drosselgasse	150	1290	1,519	0,3	1	Follow-up rinse after control interval
17.02.20	Sample city	Seaside town	H1017 Drosselgasse	150	1755	9,307	1,3	5	Need for action, e.g. repeat rinsing
17.02.20	Sample city	Seaside town	H1018 Amselweg	150	1450	1,652	2,8	2	Follow-up rinse after control interval
18.02.20	Sample city	Seaside town	H1019 Finkenstraße	200	3900	2,096	3,0	4	Need for action, z. e.g. repeat rinsing
18.02.20	Sample city	Seaside town	H1020 Newt path	200	4400	1,552	0,8	1	Follow-up rinse after control interval
18.02.20	Sample city	Seaside town	H1021 Newt path	100	2285	8,418	1,8	5	Need for action, z. e.g. repeat rinsing
18.02.20	Sample city	City center	H1022 Kaiserallee	150	2560	4,393	2,8	4	Need for action, z. e.g. repeat rinsing
19.02.20	Sample city	City center	H1023 Kaiserallee	150	2110	9,568	2,5	5	Need for action, z. e.g. repeat rinsing
20.02.20	Sample city	City center	H1024 Hammannallee	100	1100	7,838	1,8	5	Need for action, z. e.g. repeat rinsing
20.02.20	Sample city	City center	H1024 Hammannallee	100	1100	10,332	1,5	8	Urgent need for action, z. e.g. Comprex cleaning

Table 2 - Practical examples of water suction flushing

Features Total length	Example 1	Example 2
Sections Nominal	61 km	168 km
width Materials	28	113
Personnel Service	DN 80 to DN 300	DN 65 to DN 300
provider Personnel	GG, GGG, steel, PE	GG, GGG, steel, PE, AZ, PVC
Operator Duration	2 Technician	2 Technician
Special features	1 pilot	–
	14 night shifts	30 day shifts
	Combination with Valve inspection	Regular Repeat rinsing

Clean pipes and functioning fittings are essential for the high operational safety of the drinking water supply. Only functional fittings enable routine water flushing by the pipe network operator or their service provider based on a flushing schedule.

Operators and service providers work hand in hand

In recent years, it has been shown time and again how useful it is to carry out maintenance measures together. Different variants are possible. The service provider can also take on different tasks depending on the operator's personnel availability. The work is spread over several shoulders. In today's world of skilled labor shortages, this is helpful in maintaining distribution grids properly and economically. Here are two examples of measures carried out, one of which was supported by the operator (Table 2). Examples of pipe network cleaning and valve inspections, possibly with valve upgrades (Comprex netcare), have already been described several times [1, 2, 3]. Recently, the combination of water suction flushing and impulse flushing methods has been used more and more frequently.

Water suction flush and Impulse rinsing processes complement each other

At the beginning of 2020, the municipal utilities of a municipality with 20,000 inhabitants due to contamination problems in the pipe network. Initially, attempts were made to counteract the contamination with a boiling ban and drinking water disinfection. This caused odor problems. The reaction of the disinfectants with existing iron and manganese deposits continued to trigger re-dissolution processes in the network. Initially, it was only planned to clean the large DN 500 and DN 600 supply pipes from the waterworks to the distribution network using the impulse flushing method. Due to the problems described above, the municipal utilities finally decided to completely flush and clean the entire network with a length of approx. 130 km. A combination of water suction flushing and impulse flushing was used.

In the first step, two synchronized Comprex units cleaned the large-diameter supply lines over three days. This was followed by systematic water suction flushing over 30 working days. This allowed turbidity hot spots to be identified in the drinking water network. The hot spot analysis revealed 16 critical pipe network areas totaling around 20 km. The impulse flushing process was then used in these areas for a period of three weeks.

Literature

[1] 20 years of preventive network maintenance in Rüsselsheim, wwt 9-2021, 50-53.

[2] Experiences with Comprex netcare at Stadtwerke Steinfurt, energie | wasser-praxis 7/8-2012, 112-113.

[3] Effective grid maintenance increases operational reliability, energie | wasser-praxis 3-2017, 110-111.

Cited rules and regulations

DVGW Code of Practice W 291, draft 9/2020; Cleaning and disinfection of water distribution systems.

DVGW Code of Practice W 400-3-B1; Technical Rules for Water distribution systems (TRWV) - Part 3: Operation and maintenance - Supplement 1: Inspection and maintenance of local networks.

DIN EN 805; Water supply - Requirements for water supply systems and their components outside buildings.

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