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Efficiently clean **contaminated water distribution networks with CompTex**

If the drinking water distribution network is contaminated, the network operator must react immediately. As a first measure, he usually prescribes a boiling ban or has chlorine added to the drinking water for disinfection. However, it is important to determine the cause of the contamination, take measures against it and ultimately remove the contaminants from the network. The mechanical cleaning of contaminated water distribution networks using the Corn.prex. impulse flushing process has proven its worth in many cases. This is demonstrated by various applications from the Praxü.

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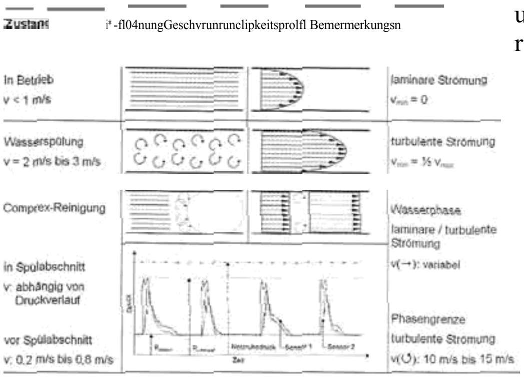
The consumer expects safe drinking water. This requirement is laid down in the Drinking Water Ordinance. It regulates the test parameters and the frequency of water tests. However, contamination problems occur time and again, i.e. the microbiological parameters are elevated and the corresponding limits are exceeded. The distribution network is microbiologically contaminated. There has often been an entry from outside.

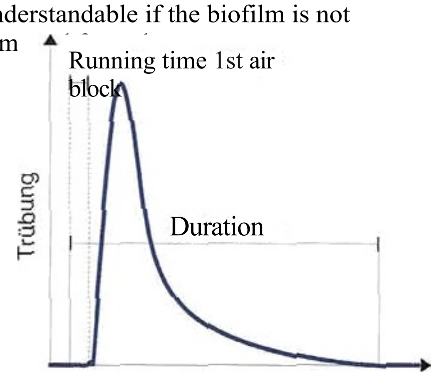
In contrast to decentralized contamination at individual sampling points, systemic contamination means that the contamination is present at several sampling points in the water distribution system at the same time. Possible causes of systemic contamination with coliform bacteria and measures for a graduated approach to the detection of these microorganisms in drinking water are described in a £publication by the Federal Environment Agency [i].

Possible causes of systemic contamination in the distribution network are contamination in containers, poorly maintained raw nets, recontamination in the distribution network, entry of microorganisms into the distribution network due to technical faults, inadequate disinfection in the elevated tank / distribution network, impermissible connection with other water systems or microorganisms from biofilms on component parts {i]. In the cases described here, the causes were: a leaking ceiling of an underground tank, the entry of sludge after a storm and a fault in the water treatment process at the waterworks. T he following procedure is typical for t h e detection and initial measures: First, the contamination is detected by exceeding the limit or guideline values of the microbiological parameters. In the next step, the drinking water is chlorinated, often with an increased dose of chlorine, and in some cases also flushed with drinking water. This ensures compliance with the limit values of the microbiological parameters in accordance with the Drinking Water Ordinance. However, this measure i s not a permanent solution. As a result of the increased chlorine dose, consumers who are used to d r i n k i n g pure drinking water complain. The water distributor comes under pressure when the concentrations of the mArobiological parameters increase after the chlorine dose is reduced. This process is understandable if the biofilm is not rem

In most cases, this first measure provides the necessary time to determine the causes of the contamination and to restore the distribution system to a hygienically perfect condition. It is extremely important to reliably remove the impurities from the water distribution system. Comprex cleaning plays a key role here.

There is a widespread opinion that drinking water disinfection can eliminate contamination. However, studies show that this is not true in many cases. Depending on the pH value, chlorine is present in drinking water as a hypochlorous acid or hypochloiite and can attack the upper layers of the biofilm, but can only penetrate it to a limited extent. Detached parts of the biofilm are distributed with the drinking water. However, the remaining dead parts serve as a nutrient substrate for other microorganisms, so that new populations multiply after the chlorine dose is reduced. More microorganisms grow on the surface. Some of them pass into the flowing water and lead to increased concentrations of microbiological parameters.





V.L.N.R.: FIG. : MODEL HOF7E OAR LEADING AT BETAIE B, WATER P O LU NG U ND COMPREx-R r J N IGU NG E| NER ROHRL EIT AB 8. 2:
PRINCE IPI £ LLER Te ÜBUNG SVERLAU F WÄHAEN D DE R ÜOMPR cx-REI N IGU NG
FIG. 3 TRü BES SPÜ rWASSE Q I SIGHT GLASS DURING THE OOMPREX CLEANING PROCESS

A further effect was discovered in recent studies. Biocides can put microorganisms into a kind of dormant state (VNBC = viable but not cultivable) [2]. This means that they cannot be cultivated and detected using conventional methods, but are still alive and can be detected using new methods. In this protective state, they survive the stress caused by biocides and multiply again when the biocide content is reduced, for example on the killed biofilm as a nutrient substrate.

Based on the new findings, only efficient cleaning will achieve the goal. It must mobilize and reliably remove the impurities, but must not damage the pipe materials.

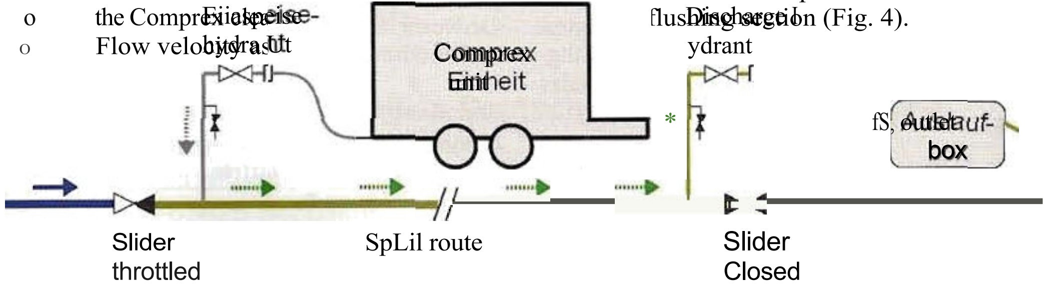
The Federal Environment Agency recommends intensive flushing of the distribution network in the event of contamination. Flushing with water is easiest at flow velocities of 2 to 3 m/s. However, it has been shown time and again that this method is not sufficient. In many cases, it is not possible to provide enough water to achieve the required flow rates. On the other hand, the disposal of flushing water via normal hydrants often causes problems,

Corriprex pulse rinsing process In contrast to rinsing with water, Comprex cleaning uses drinking water sparingly and still achieves a more effective cleaning performance thanks to the air pigs. These effects are illustrated in Fig. i. In contrast to water rinsing, where a continuous turbulent flow acts on the impurities and deposits, Comprex air pigs change the flow rate.
the Comprex process
Flow velocity as it

from the air pulses. Fig. i below shows the pressure curve during a Comprex cleaning process [3]. Two pressure sensors positioned at different distances are used to measure the pressures. Due to the buffering effect already in the pipe voxhanderex air blocks (air pigs}, the flow velocity of the water blocks changes. The water enters the flushing section at flow velocities ' i m/s and has a laminar flow. The water blocks are accelerated by air pulses. Turbulence with flow velocities of io m/s to i5 m/s form in the water/air/pipe wall boundary areas. The intermittent centrifugal velocities induce an extremely intense drag stress. The turbulence at the phase boundaries between the water and air blocks continues to cause controlled ilavitation. Impurities and deposits are mobilized.

The discharge of impurities can be monitored based on the turbidity of the rinsing water. Fig. 2 shows the basic course of turbidity during Comprex cleaning. The turbidity curve tends to correspond approximately to the discharge of biofilm. This means that no more biofilm is discharged when the rinsing water is clear and the pipe can be described as cleaned. Fig. 3 shows a sight glass. Here the turbidity of the flushing water can be visually recognized and the course of the turbidity can be followed.

The Comprex pulse flushing process is based on a controlled, pulsed addition of compressed, quadruple-filtered air from a Comprex unit into flushing section (Fig. 4).



\B B. 4: PRI N2 t P D E S I M P U LS-SPÜ L-VE e FAH P E NS COM P9 EX

The pipe network pressure is lowered and the pulse pressure of the air is set below the pipe network pressure. The air blocks that form at the feed point move alternately with water blocks by means of a spitlab cut. Mobilizable deposits are detached from the pipe walls and removed with the flushing water (Fig. j)

As the impulse pressure is below the resting pressure of the pipe network, the pipe system is not exposed to higher pressure loads than during normal operation. Damage is therefore practically impossible. The air blocks in the Comptex process can be understood as air pigs. They adapt to the cross-section of the pipe and do not get stuck. Different nominal widths or even branches do not pose a problem. Compared to conventional pigging technology, the simplicity of the Comprex process is impressive. Using connections such as hydrants or ventilation openings, the air pigs can be easily produced with computer support based on pipeline parameters by adding purified air. In distribution networks, hydrants are normally used to feed out the flushing water. Fig. shows a feed-out via standpipe and sight glasses and outlet box.

As the pulse flushing process works with time-limited flushing in predetermined pipe sections with low water demand, the rest of the supply network remains unaffected. Only in the pipe sections to be flushed may no water be taken by the residents.

Practical examples illustrate possible procedures for cleaning contaminated drinking water networks (Fig. 6).

Practical example i: Damage to buildings
Contaminated water and impurities penetrate due to leaking or leaking system components. In this specific case, it was the Tank top, leaking cover

or defective grilles.

A municipality in southern Germany has its own waterworks. During a routine drinking water test, coliform germs were detected in high concentrations. The municipality reacted immediately, initially with daily flushing of the drinking water network. In coordination with the public health department, chlorine was added to the drinking water for disinfection and an extensive investigation into the causes was begun.

The search for the cause, which also involved a microbiological laboratory, initially yielded no clear result. However, it could be ruled out that the cause of the contamination was in the wells or in the treatment systems. After cleaning and inspecting the two suction tanks, it was finally discovered that the flat roof of a deep tank was leaking - presumably the cause of the contamination. Defective grates were also replaced as part of the renovation. The municipality supplied its entire water distribution network with the impulse

PRAXISBEISPIELE	Beispiel 1	Beispiel 2	Beispiel 3
Rohrnetzlänge	70.000 m	3.000 m	11.000 m
Nennweite	DN 80-250	DN 75-100	DN 63-250
Werkstoff	GG, PVC, PE	PE	PE, PVC, GG
Netzdruck	3,5-5,4 bar	5,5	4,0-4,6 bar
Anzahl Spülabschnitte	101	1	8
Länge Spülabschnitte	70-2.255 m	3.000 m	510-2.300 m
abgesenkter Druck*	0,8-2,3 bar	1,5	1,5-2,0 bar
Impulsdruck*	3,0-5,1 bar	5,0	3,5-4,0 bar
Dauer pro Spülung	1,0-10,0 h	8,0 h	3,5-11,0 h
Länge täglich gereinigter Spülabschnitte**	250-2.255 m	3.000 m	1.350-2.300 m

* abhängig vom Spülabschnitt, **abhängig von örtlichen Gegebenheiten und vom Ausmaß der Verunreinigungen

FIG. 5: OFF5 RINSE WATER PURGE DURING A COMPA rx-R rl NIG

FIG. 6: PROJ EI£T DATA IN u BERBL\CK

flushing process. This not only removed biofilms, but also deposits that had formed in the net over the years. The water samples taken no longer showed any abnormalities.

A positive side effect of the flushing work was the updating and completion of the plan. Due to the extensive pipe network flushing, almost every 5 valves in the network were operated at least once. This made it possible to quickly identify and correct discrepancies in the plans. Poorly closing valves were detected and often made fit for furi-cation again.

Practical example z: Storm damage

During storms with heavy rainfall, mud and surface water enters the water supply system. It is taken out of operation and an emergency supply is set up.

In the summer of zoo8, a storm in eastern Germany led to flooding in the area of a road connecting two districts of a municipality. Sludge masses flooded the road, penetrated the booster station and finally contaminated the earth tanks via the ventilation valves. Immediately after the storm, the sludge water was sucked out and the underground tanks were cleaned. This was followed by pipe network flushing by the municipality. The responsible health authority ordered disinfection of the booster station and the underground tanks. At the same time, the section of pipe contaminated with sludge was cleaned using the Comprex process. During this time, the population continued to be supplied with drinking water from water tanks. After cleaning, the water analyses no longer showed any abnormalities. The network was able to go back into operation.

Practical example 3: Fault during water treatment in the waterworks

In the distribution network of a medium-sized city in northern Germany, the microbiological values. As a measure, the responsible municipal utilities decided, after consultation with the health department, to clean an area of approx. 30 krri of pipe network and to continue to monitor the remaining area intensively. The Comprex cleaning, which was ordered as an emergency measure, was successful. The water samples taken afterwards no longer showed any flare-ups.

Conclusion

In the event of incidents, measures must be taken immediately to supply the population with clean drinking water. The causes of the impairment that lead to the contamination of drinking water are usually impurities in the drinking water systems. If the causes of the contamination are klax recognizable, such as e.g. the consequences of storms, can be take targeted cleaning measures. If it is suspected that leaks in systems are leading to the introduction of contaminants, the paths must first be localized, the system cleaned and the subsequent water distribution system completely cleaned. The Comprex process has proven to be an efficient method, as only clean pipes can transport drinking water hygienically to the consumer.

Literature

[i] Recommendation of the Federal Environment Agency - Coliform bacteria in drinking water; BundesgeSundheitsbl. 4 2OO9 S. 474 482.
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