

Case report

Accidental contamination of a German town's drinking water with sodium hydroxide



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ABSTRACT

Case report of a very serious drinking water incident putting up to 50,000 inhabitants of a town near Bonn in North Rhine-Westphalia, Germany at risk. A concentrated solution of highly alkaline water by sodium hydroxide was accidentally washed into the town's drinking water at a pumping station and increased the pH-value of the water to 12. Residents who came into contact with the contaminated water immediately had a toxic reaction. The incident was detected by complaints from customers and after that was stopped within several hours. The pipes were flushed and the customers were warned not to use the water till the all clear. After this immediate management there was an investigation and the cause of the incident was detected as an accidental release of accumulated sodium hydroxide (NaOH) solution. The lack of a network alarm system and the automatic cut-off mechanisms as deficiencies in the design of the station were rectified by the water company immediately after the incident.

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Case report of a very serious drinking water incident putting up to 50,000 inhabitants of a town in North Rhine-Westphalia, Germany at risk. A concentrated solution of sodium hydroxide was accidentally washed into the town's drinking water at a pumping station and increased the pH of the water to 12. Residents who came into contact with the contaminated water immediately had a toxic reaction. The incident occurred on a weekday in late spring 2013.

This report describes the cause of the incident and the clinical reactions of those affected by the highly alkaline water.

Description of the incident

Shortly after 16:00 on a weekday in late spring 2013 the municipal water company in Bornheim started receiving complaints from customers about the water. It had an odd consistency although there was no unusual smell. The complaints all came from the lower lying area of the town. One of the first complaints was from a man who reported that his skin and scalp had turned red, and he felt pain and a burning sensation wherever he had been in contact with the water (Figs. 1–3).

The water company called in its standby duty team and increased the flow of water through the pipes. At first the water

company suspected allergic reactions as a result of the cleaning of the municipal water pipes earlier in the day. Then the standby duty team realised the water had a soapy consistency and they detected a pH value of 11.96. They identified the source as a sodium hydroxide (NaOH) solution. They cut off the supply of this solution and further increased the flow of water through the pipes. In the meantime the company had arranged for the inhabitants of the streets where the complaints had come from to be warned. The police and fire service went door to door advising the residents not to use the water until the all clear. At 22:00 the flushing of the pipes was complete and the pH value was back to normal levels. The all clear was given.

The authors were commissioned by town B to investigate the health aspects and the management of this incident (WHO, 2011; Bundesministeriums der Justiz und für Verbraucherschutz, 2013; Bundesgesundheitsministerium, 2013).

Cause of the incident

An external expert was commissioned by Bornheim to investigate the incident and identify how the accident happened.

The water company uses two different drinking water sources (groundwater and reservoir water) which are mixed at an unmanned pumping station. Diluted sodium hydroxide solution is added to raise the pH value to 7.4–7.6. Sodium hydroxide is an officially approved substance for adjusting the pH of drinking water

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Fig. 1. Exterior view of unmanned pumping station. As can be seen, it sits in a field.



Fig. 2. Soft water tank, black. The concentrated caustic soda was pumped backwards into the soft water tank and accumulated there to form a highly concentrated solution.

(Bundesministeriums der Justiz und für Verbraucherschutz, 2007). At the pumping station in question soft water held in a 1000 l tank is used to dilute the NaOH solution. A pump boosts the soft water and releases it into the drinking water pipe through a dosing lance. The concentrated caustic soda is usually dosed into the suction pipe of this pump.

The investigating expert believes that due to a clogging of the dosing lance the flow of the diluted sodium hydroxide into the drinking water was interrupted. Since the dosing of the concentrated caustic soda was not stopped, the concentrated caustic soda was pumped backwards into the soft water tank and accumulated

there and formed a highly concentrated solution. This could have been prevented with a better designed system and state of the art monitoring.

Earlier on the day of the accident, the dosing lance had been cleaned. When normal service resumed at 14:10 that day, the concentrated sodium hydroxide in the soft water tank was released into the drinking water main pipe and the contaminated water got into the network. The investigation report points out that the sensors in the main pipe only registered the raised pH with a lag time of 60–90 min. Furthermore, the alarm only rang locally (the station is

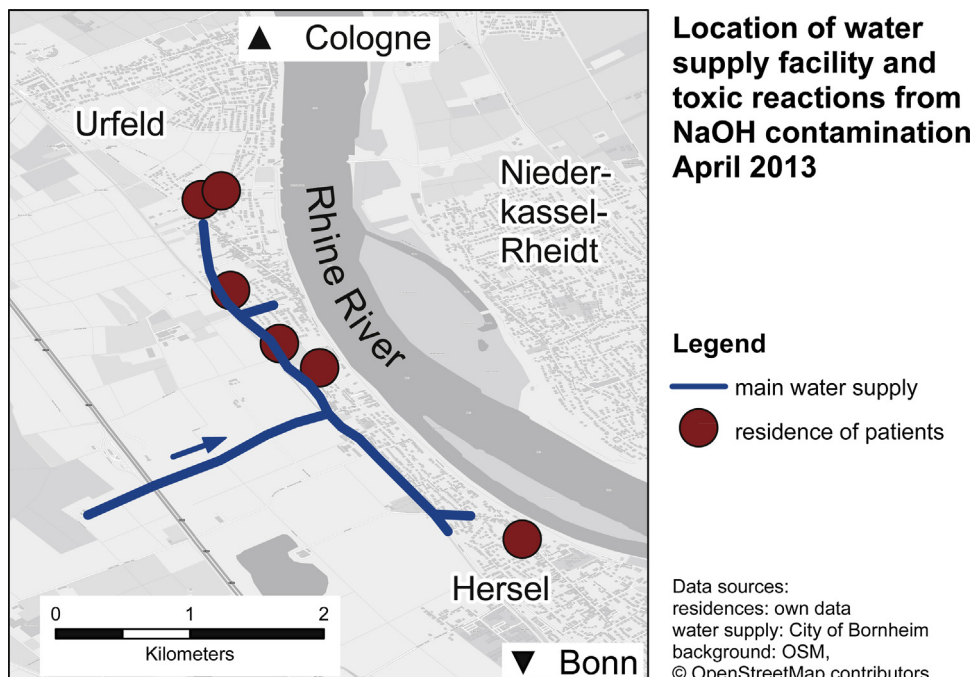


Fig. 3. Blue marked are the streets with contamination and red the reported complaints. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)

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