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Influence of Aquifer Thermal Energy Storage (ATES) on groundwater chemistry: an overview of several cases in Belgium

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Environmental concerns and an increasing pressure on fossil fuels cause a rapidly growing interest in renewable energy. An interesting provider of such renewable energy is Aquifer Thermal Energy Storage (ATES), where groundwater in the aquifer is used as storage medium for summer heat and winter cold. The number of ATES systems has been continually increasing over the last years and will continue to increase in the future. Because ATES is often applied in aquifers also used for the production of drinking water, drinking water companies and environmental agencies are concerned about the impact of all these ATES systems on the groundwater quality in the long term. Because most ATES systems operate at relatively small temperature differences, ranging to several °C above and below the natural groundwater temperature, several studies show that the temperature influence on the groundwater quality is negligible. Mixing of the water column, on the other hand, possibly affects groundwater quality. The water is often extracted over a large portion of the aquifer in order to come to the desired flow rates. The composition of the groundwater on this interval may, however, differ from the top to the bottom by interaction with the surrounding aquifer material.

The aim of this study is to evaluate the influence that Aquifer Thermal Energy Storage may have on the groundwater quality. Therefore the groundwater chemistry around seven ATES installations in the north of Belgium (Flanders) is evaluated. The selected ATES systems are located in several aquifers, which have major groundwater resources. The warm and cold wells of the different ATES installations were sampled and analyzed for the main chemical constituents during 4 to 7 years. The time series of the different chemical compounds are investigated per ATES well and compared with time series of several monitoring wells in the exploited aquifer.

Results confirm that the temperatures occurring in the ATES systems do not affect the groundwater chemistry, since no major differences in chemistry were found between the warm and cold wells. There are some differences between the groundwater chemistry in the ATES wells and the ambient values, but the differences are not large and there is no immediate threat for drinking water production. Further monitoring however is recommended especially for existing and future ATES systems near drinking water production areas.