Optimized Dewatering Wells for Open Pit Mining to Prevent Well Loss from Ochre Formation

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Extended Abstract

The lignite mining industry in the Rhenish district has to pump ca. 570 Mio. m^3 groundwater each year to facilitate open pit mining. Around 1,500 wells are in production and each year a cumulative length of 35,000 m or approx. 200 wells is newly drilled. Obviously, it is of high economic interest to push the yield of wells to an optimum, although dewatering wells have in general a much shorter lifetime than water supply wells. Well clogging by ochre formation is a common reason for well loss and increasing maintenance of e.g. the pumps. The paper reports about 5 years of research and experience in optimizing well design and well operation to prevent or at least minimize ochre formation.

We studied processes of ochre formation in an unscaled experimental rig to investigate kinetics of ochre formation and influences by e.g. filter pack or screen length [1]. This was compared with ochre observed in the wells and sampled from excavated wells inside the pits including studies about the microorganisms producing ochre inside the wells [2]. Understanding the leading processes, the well operation and well design was improved. The two most effective measures were operating the well with respect to certain water levels instead of discharge values and using the annular space for dewatering higher aquifers to avoid screens.

Sediments in the Rhenish district have a modest content of pyrite of 0.1 – 0.3 % pyrite-S, part of which is oxidized during the dewatering. Some aquifers have optimal conditions for ochre formation, i.e. 0.1 – 0.6 mg L^{-1} O_2, 2 – 4 mg L^{-1} Fe, and bacteria like Leptothrix ochracea were found. Yet, it was not possible to establish an aquifer specific water type susceptible to ochre formation to use this as a management tool. The most serious influence was by groundwater enriched in oxygen from the gas phase in the open casing section of the wells. The two measures mentioned above both have in common that intake of ground water into open casing sections is avoided.

Until recent years dewatering wells in the Rhenish district were installed with several screens. Due to high pumping rates upper screens often fell dry and allowed seepage getting enriched in oxygen in the open casing running down or splashing into the lower well sections. In an optimized well operation the drawdown of the well was set to the upper level of the highest screen as long as possible. To do so, a high number of wells got re-equipped with controllers to regulate the pumping rate.

Special dye tracer tests showed that the annular space and coarse filter pack were sufficient to enable dewatering of one aquifer by a screen installed in the next deeper one. Again, ground-water will not get into contact with the oxygen in the open casing. This has become the common design of wells drilled for open pit dewatering in the Rhenish district in recent years except for wells outside the mining field.

Key words: Open pit dewatering, ochre formation, well operation, well design

References

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