Water treatment with Lewatit® ion exchanger for H_2 production in Proton Exchange Membrane electrolysis (PEM)

PEM electrolysis is expected to play an important role in the transition towards a hydrogen-based economy. Due to its excellent dynamic response time, PEM electrolysis is a perfect solution for storing curtailed, excess renewable energy. Moreover, the advantage of high current density operation makes it possible to produce more hydrogen from smaller setups compared to alkaline electrolysis. Due to the high-pressure outlet of hydrogen, PEM electrolysis technologies can be directly connected to gas stations.

Application

The PEM technology for producing hydrogen contains several water cycles. Makeup water to compensate for water loss during the production of hydrogen is also needed. To ensure stable H_2 production and the longevity of the stack, it is important to remove the impurities (fluoride, metal, TOC) that are released during the process. The water cycle is polished by a lateral partial flow to stabilize the quality of the process water. The main process water cycle is needed on the anode reaction, where the process water (100 MW PEM) cycle is approx. 6000–7000 cbm/h.

Example of system design

Below is an example of the water treatment required for a 100 MW PEM that produces approx. two tonnes of hydrogen per hour. Necessary treatment with ion exchanger:

- Makeup water
- Hydrogen water cycle
- Oxygen water cycle

A water resistivity between 10–18 MOhm*cm is recommended by LANXESS in order to achieve low ppb values for fluoride and metals in the PEM system.

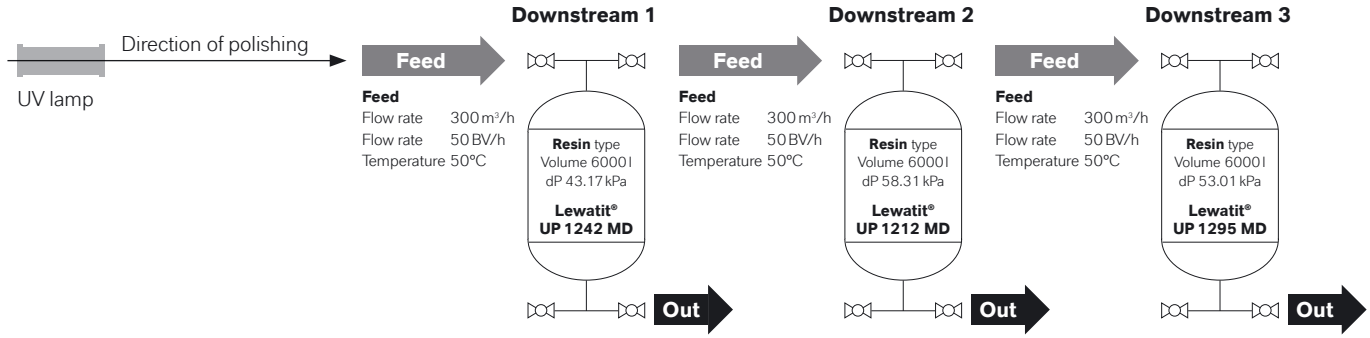
Lewatit®

Use of Lewatit® UltraPure ion exchangers

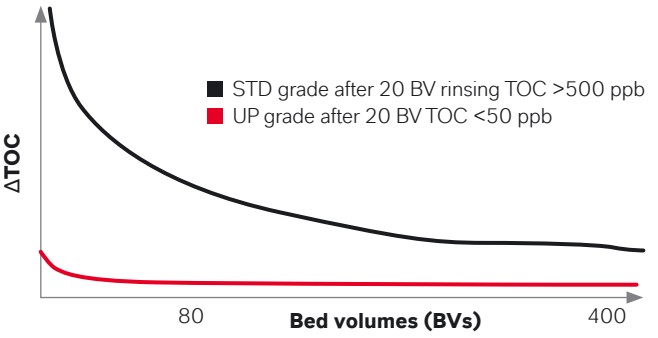
Because of higher operating temperatures (50–70°) in the PEM process, we not only have impurities released during the PEM process, but also the TOC released by the ion exchanger installation, which could increase the organic (TOC) content of the process water. Therefore we have designed a special method of treating the process water with Lewatit® UltraPure resin types in combination with a UV lamp.

Recommended Lewatit® UltraPure resin types

Anion exchanger	Lewatit® UltraPure 1242 MD SBA type 1
Cation exchanger	Lewatit® UltraPure 1212 MD SAC
Ready-to-use mixed bed	Lewatit® UltraPure 1295 MD



Reduction of TOC release in the starting phase



Lewatit® UP resins with low TOC release directly after installation are helping to ensure low TOC levels in the closed PEM water cycle.

Summary

Because of the TOC issue in the PEM water cycle, we recommend installing a UV lamp to reduce TOC levels. We recommend installing the SBA filter first to remove the degradation products (TMA), followed by the SAC filter. The SBA cycle time depends on the amount of emerging CO_2. The co flow application is flexible for various throughputs and easy to use. We recommend UltraPure quality resin to reduce the amount of TOC in the system during the starting phase.

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