# Experimental Investigation on Material Selection for Pump and Machinery to Remove Ochre Deposits

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**Long Abstract**

## Introduction

Ochre deposits i.e. iron clogging, is one of the main reasons for downtime and maintenance demand by pumping from wells. In addition it leads to a significantly increase of friction losses in the involved system and causes thereby increased energy costs. Affected of iron clogging are the field of open-pit mining as well as the industry of drinking water production. The current common method of cleaning from ochre depositions leads to the shutdown of the well and requires the removing of parts.
Therefore, there is the attempt not to prevent the system from ochre deposition, but rather to develop a simple concept to clean a system insitu if it is already iron clogged. This has the advantage of a reduced maintenance time as well as the possibility to operate the system more economical since purification is frequently possible.

**Figure 1.** Example of Ochre Deposits on the Diffusor of a Submersible Pump

Methods for the insitu purifying of clogged system exist already. For example, the process of flushing water or a water-air-mixture could be used proposed by the *DVGW* [1]. Therefore, it must be considered that it is unclear how to applicate this process to iron clogged systems as it is not design to clean such systems.
However, it is unknown for which flow velocities ochre dissolves and how this related to the used material. This paper examines therefore experimentally the flow velocities for which ochre resolves and relates this in addition to different materials and coatings.
It was found that the necessary flow velocities for an ochre resolve are higher than technically relevant flow velocities which are assumed to be 1 to 2 m/s.

Further experiments were carried out to determine the design of a geometric shape, which increases the flow rate locally and thus lead to the rate of determinate remove velocity. The system velocity is thereby still a technically relevant speed and the geometric condition produces locally the necessary speed to remove ochre.

## 1. Methods

Sample carriers of different materials and coatings were exposed to the process of iron clogging (compare Figure 2). The materials were stainless steel and PE, brass, copper, and various epoxy resin coatings (2K-Epoxi, SiC- Epoxi, SuperL-Epoxi) as well as PC 5572, NanoLack and Teflon. These represent standard materials and coatings in the industry of pump and machinery. For each configuration there were three sample carriers to guarantee a repeatability of the experiments. The samples were three months exposed to iron clogging until thicknesses of ochre were grown up to 30 mm.

**Figure 2.** Sample Carriers Clean (left) and Iron Clogged (right)

The grown layers of ochre were comparable to those which are found at iron clogged, hydraulic components in wells. Thus, on the surface of the samples was an inertial layer, which was hard and aged. Furthermore, there was a second layer, which was soft and could be easily detached. Likewise to hydraulic components is the grown ochre of the samples inhomogeneous in texture.
An experimental test series was done to exanimated the value of volumetric flow velocity for which the ochre remove from the sample carriers. Further, the alteration of ochre thickness respectively the resolving of ochre with graded increasing velocity was observed. It was shown that these velocities are above technically relevant flows in the system. Therefore, a second tests series was carried out to define a geometric conditioning that generates due to the nozzle effect the locally necessary velocity to remove ochre. The geometric conditioning consisted of a nozzle in quarter circle shape with diffusor downstream and was mounted around the sample carrier. The geometry was adapted until the determined necessary flow velocity to remove ochre was locally achieved. The local velocity around the sample carrier was determined by use of the Laser Doppler velocimetry measurement method. Thereby, the measurement was made up close to the wall of the sample carrier so that the boundary layer was considered.
The results give information about the flow velocities and profiles to remove ochre depending on different materials and coatings. In addition a geometric condition was developed that leads to a local velocity, which is equal or higher to the identified remove velocity.

## References


[1] DVGW. Reinigung und Desinfektion von Wasserverteilungsanlagen (Cleaning and disinfection of water distribution systems). *DVGW Arbeitsblatt W 291*. In German. ISSN 0176-3504. March 2015