Kinetic data for the adsorption of nickel ions from aqueous solutions

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The global demand for clean water is constantly increasing due to increasing population numbers as well as worldwide economic growth. With the limitation of clean water as a resource, the treatment of wastewater attaches particular importance. Over 80 % of the global wastewater is discharged without any treatment [1]. Especially untreated industrial process water causes environmental pollution and consequently affects human health. Pollutants are often valuable materials, such as nickel, which is widely used in metal working industry as well as a component in lithium ion accumulators and catalysts. Clean water technology based on adsorption as a sustainable alternative to established end-of-pipe-technologies could be able to provide both water purification and material recovery.

For the development of such processes, experimental data of the adsorption behavior are necessary. Experiments were carried out to study the nickel adsorption kinetics and diffusion for functionalized silica based adsorbents (pore sizes of 100 Å and 1000 Å) at temperatures of 5 °C, 20 °C, and 60 °C with initial concentrations of 34 µmol/L, 340 µmol/L, and 3400 µmol/L, respectively.

The results in Figure 1 contain the adsorption kinetics for the first 10 seconds with an initial nickel concentration of 34 µmol/L and adsorbent pore size of 100 Å. The data show pure adsorption kinetics within the first second until a plateau is reached. It is assumed that during this time the nickel ions get in contact with the outer surface of the adsorbent. After this plateau, the adsorption takes place at the inner surface of the adsorbent. The leveling of all three temperature dependent curves (Figure 1) shows clearly that the velocity of the binding mechanism is displaced by the rate of diffusion as the limiting factor of the adsorption process. Effects of temperature, concentration, and pore size onto the adsorption process will be discussed. A modelling of the obtained data is in progress.

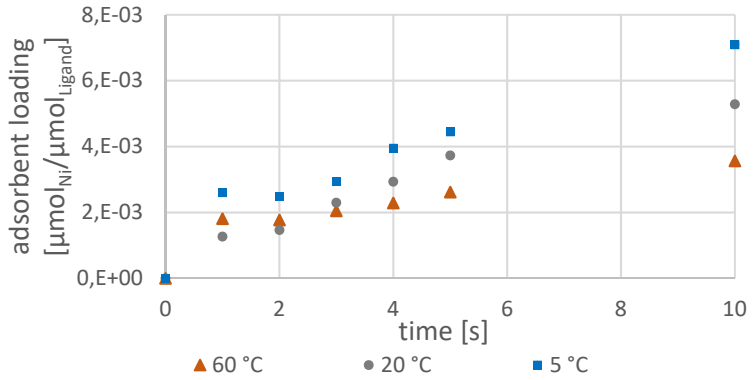

Figure 1: Adsorption kinetics with initial concentration of 34 µmol/L and adsorbent pore size of 100 Å.

References

[1] United Nations World Water Assessment Programme (2017): *The United Nations World Water Development Report 2017. Wastewater: The Untapped Resource*. Paris, UNESCO.