

Student's Card 3 Removal of heavy metals from wastewater, e.g. chemical precipitation in the automotive industry

Module 3






Objective: Quantitative test of the hydroxide precipitation

Introduction

Now that we have carried out the precipitation and estimated the amount of precipitation products, we are naturally interested in the residual content of Mn^{2+} ions in our "process water"? In the following we will use two simple detection methods.

Necessities



Reagents	Formula		Quantity (g) or Concentration (M)
Sodium hydroxide	$NaOH$		1 - molar
Hydrogen peroxide	H_2O_2	  	30 %

Lab Procedure

List of materials/tools

- $NaOH$ and H_2O_2
- beakers

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In industrial practice, all three cations (Ni^{2+} , Mn^{2+} , Zn^{2+}) as well as wetting additives are present together in the phosphating bath. In order to be able to demonstrate the success of the heavy metal hydroxide precipitation with an unequivocal detection reaction, it is necessary, for didactic simplification, to limit to one cation in the solution. Qualitative detection is possible for Mn^{2+} ions in a hydrogen peroxide sodium hydroxide solution, even in small amounts. Prepare the hydrogen peroxide sodium hydroxide solution and carefully add a few drops of the filtered solution containing Mn^{2+} ions before precipitation. What reaction do you expect? **Write the reaction equation.** The residual solubility of manganese hydroxide precipitation is 4×10^{-4} , so the process is industrially supplemented by post-precipitation with a sulphur-containing precipitant. [1] Of course, if the precipitated substance were unknown, the manganese(IV) oxide hydroxide would have to be dissolved by boiling in concentrated nitric acid and oxidised with lead(IV) oxide to form the violet permanganate in order to prove that it is manganese ions:



Since in this experiment we have only $Na^+ + 3OH^- + Ca^{2+}$ as accompanying ions in the solution in distilled H_2O and these cannot be (IV)-valently oxidised, precipitation of these ions is not possible. [2] Alternatively, the solution can be tested for the finest $Mn(OH)_2$ particles, which should have passed through the filter [\varnothing 150mm], by dripping some hydrogen peroxide solution into the solution. How should hydrogen peroxide react with Mn (II) hydroxide?



Questions/Quiz

Now please reflect on the entire workshop and outline the main steps and their purpose.

Sources

- [1] Hartinger, L., Lerch, A. (2017). Hartinger Handbuch Abwasser- und Recyclingtechnik. Komplette in Farbe, 3. Aufl. Hanser, München.
- [2] Schweda, E. (2012)-. Jander/Blasius - Anorganische Chemie. Hirzel Verlag, Stuttgart.