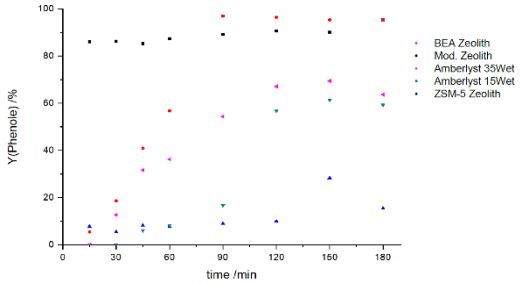
Hock rearrangement

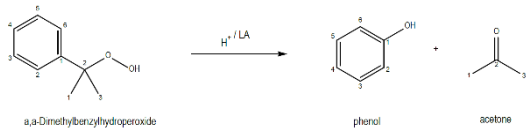
Catalyst for sulfuric-acid-free phenol and acetone synthesis

Invention

This synthesis method replaces the usual method in which sulfuric acid is used as a catalyst for the rearrangement of benzylic peroxide compounds to form phenols and carbonyl compounds (Hock rearrangement). Surprisingly, a calcined zeolite material has also been identified as a suitable catalyst. It is more environmentally friendly than sulfuric acid and causes far fewer problems with corrosion. The special treatment of the zeolite material showed that catalytic activity could be greatly enhanced.



Phenol yields in Hock rearrangement of cumene hydroperoxide in chloroform with various catalysts. 45 bar, 80 °C, 8.62 mL substrate.



Model substrate, cumene hydroperoxide

Commercial Opportunities

The most important industrial synthesis of phenols encompasses the rearrangement of benzylic peroxide compounds, which produces equal parts of phenols and carbonyl compounds. The method for synthesizing phenol and acetone from benzene and propene with subsequent peroxidation and conversion of peroxide to phenol and acetone is called the “Hock method”, named for Heinrich Hock, who invented it in the 1940s. This method features good atom economy, producing virtually no waste substances. It does require large quantities of caustic sulfuric acid, which must be recycled afterward at great cost.

Using zeolites in this invention dispenses with sulfuric acids.

Current Status

A German patent application has been submitted by the university to the German Patent and Trade Mark Office, and international applications can still be submitted. Experimental laboratory data confirm method’s functionality.

Relevant Publications

High-Temperature-Treated LTX Zeolites as Heterogeneous Catalysts for the Hock Cleavage
Jan Drönner, Karim Bijerch, Peter Hausoul, Regina Palkovits and Matthias Eisenacher,
Catalysts 2023, 13, 202. https://doi.org/10.3390/catal13010202 (open access)

An invention of the Cologne University of Applied Sciences.

Competitive Advantages

- Environmentally friendly catalyst
- No sulfuric acid
- Good yield without secondary products

Technology Readiness Level

1 2 3 4 5 6 7 8 9

Technology validated in lab

Industries

- Industrial chemistry
- Laboratory chemicals

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