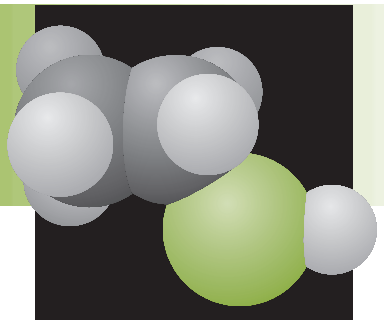
CHEMICALS
Project Fact Sheet



New Catalyst Technology for the Selective Oxidation of Feedstock Aromatic Compounds to Commodity Chemicals

Benefits

- Saves more than 65 trillion Btu per year by 2020
- Reduces wastes by more than 50 billion tons per year
- Reduces industry's capital costs
- Allows recycling of benzene after separation from phenol
- Minimizes production of carbon dioxide
- Uses a relatively inexpensive feedstock

Applications

Phenol is the second-largest commodity produced from the inexpensive raw material, benzene. Using the new technology to produce phenol directly will allow industry to accrue significant cost savings.

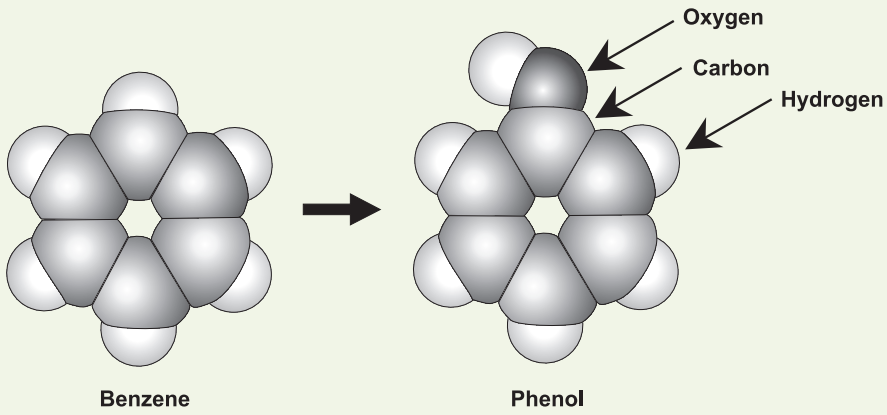
One of Akzo Nobel's business strategies is to develop new and customized catalysts. Therefore, this effort fits well into the company's objectives and will provide a base for commercialization of the new technology.

Direct Catalytic Method Will Reduce Phenol Production to One Step

Currently, the chemical industry uses the three-step "cumene process" to produce 95 percent of the 4.5 billion pounds of phenol it requires annually for manufacturing phenol-formaldehyde resins. A proposed new process would convert benzene to phenol in only one step and would eliminate the need to neutralize acids, separate organic products, or to be concerned with a potentially unstable intermediate product in the cumene process. Theoretically, the new process also produces no by-products, whereas the cumene process leaves acetone to be sold (in an over-supplied market) to make the process economical, and several other hazardous compounds that must be handled appropriately.

Selective oxidation and direct conversion of benzene to phenol were both ranked as high-priority topics for further research by chemical experts in the public and private sectors. The new process could generate considerable energy savings and reduce by-products and hazardous wastes. The bottom line result for industry will be production cost savings, a reduction in environmental impacts, and more effective carbon management.

Selective Oxidation



This project is aimed at finding new heterogeneous catalysts for the selective oxidation of benzene to phenol.

Project Description

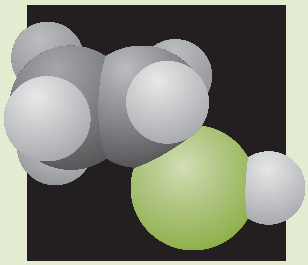
Goal: To develop an economical one-step process for converting benzene directly to phenol with a single-pass yield of at least 50 percent, and few or no organic by-products.

Technology development in the chemical industry has been moving toward high-selectivity oxidation catalysis. Previous research suggests that if a suitable form of oxygen species can be generated on the surface of a catalyst, a one-step process for oxidating benzene to phenol is feasible. Work will be carried out to design the redox component in the catalyst in order to generate the oxygen species with molecular oxygen as the starting point. Several other oxidants will also be studied for their potential application. Investigators will then determine the use of different forms of oxidants that can be produced from molecular oxygen cost-effectively.

Investigators will examine the use of unconventional catalysts for partial oxidation. The selected catalysts will be characterized in order to gain a better understanding of their chemistry and of how they may be used to improve the benzene-conversion technology. Studies will also be conducted on the use of low-residence-time, liquid-phase reactors during new-catalyst synthesis.

Progress and Milestones

- Bench-scale development and testing of catalysts is the first focus area.
- Four tasks related to formulating, characterizing, and testing new catalytic systems will run concurrently to realize technological breakthroughs on a shorter time scale.
- Scale-up and testing of the most promising catalysts will be undertaken.



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