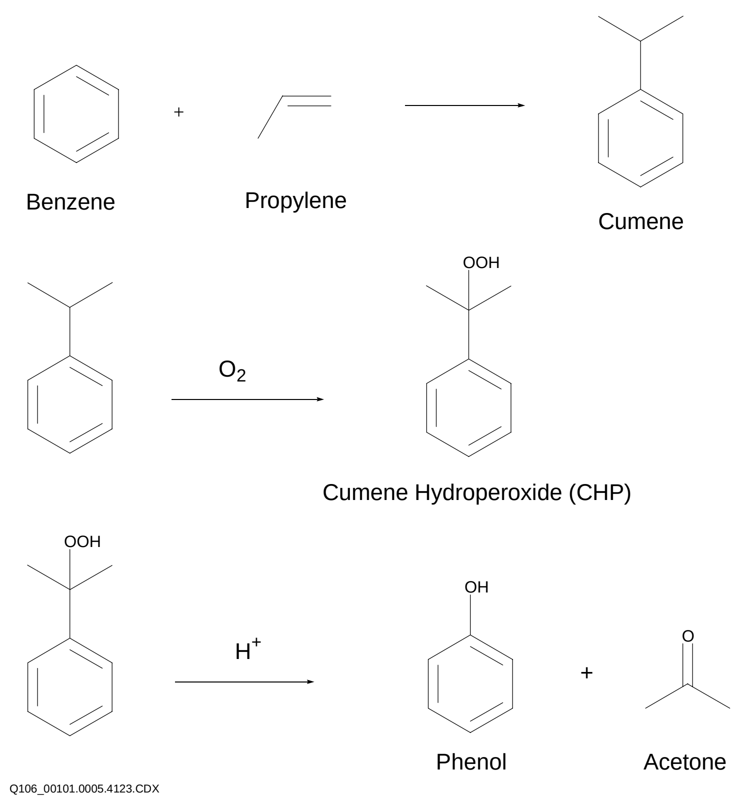
PERP Program – Phenol/MEK Co-Product Process
New Report Alert

June 2006

Nexant's *ChemSystems* Process Evaluation/Research Planning program has published a new report, ***Phenol/MEK Co-Product Process (04/05S12)***. To view the table of contents or order this report, please click on the link below:
http://www.nexant.com/products/csreports/index.asp?body=http://www.chemsystems.com/reports/show_cat.cfm?catID=2

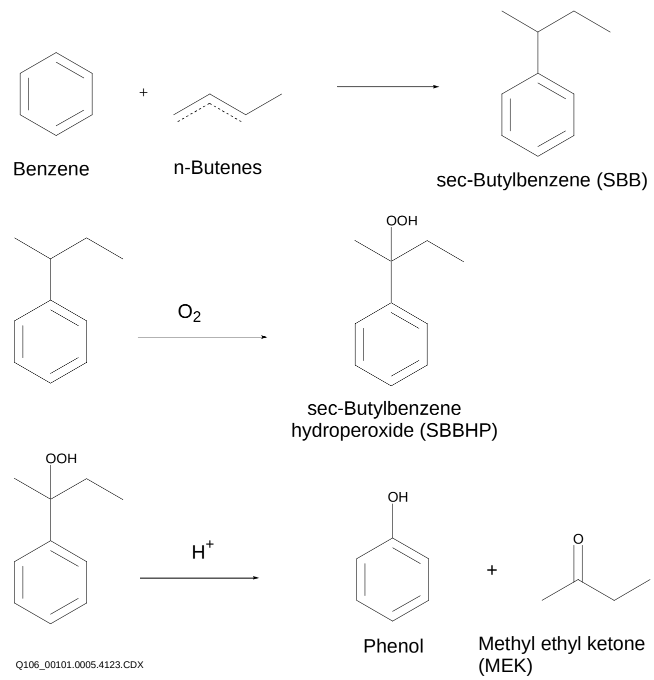
Introduction

In 2005, 98 percent of the world's phenol was manufactured by the cumene-based acetone co-product process. In this process, cumene is formed through the alkylation of benzene with propylene and is then oxidized with air to form cumene hydroperoxide (CHP). Concentrated CHP is then cleaved to yield the co-products phenol and acetone, which are further purified in a downstream fractionation section.



This type of technology is termed a “2 for 1” process. 2 for 1 processes are generally considered to be low cost routes but require market demand for both products to be growing in the same ratio as is produced in the process. In the case of phenol and acetone, there is concern that the phenol market will outpace the acetone market due to the strong growth of bisphenol A for the polycarbonate market (bisphenol A requires two equivalents of phenol for every one equivalent of acetone). Thus, in order to keep up with phenol demand too much acetone will be produced causing the price of acetone to decline. Declining acetone prices will penalize phenol costs as acetone is taken as a by-product credit.

To overcome this problem, Shell Chemical has announced their intention to commercialize a new phenol process in Asia that will mitigate the problem of acetone over-supply. This approach is believed to involve co-oxidation of cumene and sec-butylbenzene to give phenol and acetone and MEK as by-products. Sec-butylbenzene (SBB) can be made via alkylation of benzene with n-butenes. The chemistry of this route is shown below (simplified in that the co-oxidation of cumene to CHP is omitted).



Economic Analysis

The relative cost of production of the Shell process to co-produce phenol, acetone and MEK is compared with the conventional phenol-from-cumene route for co-production of phenol and acetone.

For the pricing assumptions made for this analysis, the cash cost and the cost plus ROCE for the Shell process route are advantaged as compared to conventional phenol/acetone co-product technology.

Although the costs for making cumene and SBB were found to be almost identical, the raw material costs for the Shell phenol process are 10 cents per pound higher as compared to the conventional cumene-only based phenol process. This is because the unit consumption of SBB is significantly higher than the unit consumption of cumene due to SBB's higher molecular weight and the fact that the yield to phenol is somewhat lower. However, where the Shell process has a large advantage over the conventional phenol process is in the very large by-product credit received for the MEK, which more than makes up for the higher raw material costs.

The Shell Phenol/MEK/Acetone process appears to be a very interesting technology that will allow the effects of the ups and downs of the acetone and MEK markets to be optimized thus minimizing phenol production costs. The Shell process has the potential to change the acetone/MEK ratio, within reasonable limits, allowing co-product revenue to be maximized. Shell has indicated that they are planning to build such a plant in Asia; however, the costs and prices examined in this report are based on a USGC scenario as is the standard for PERP analyses. Because the revenue received for the co-products, acetone and MEK, is by far the major determinant of the phenol economics, it is instructive to take a look at historical acetone and MEK prices in Asia.

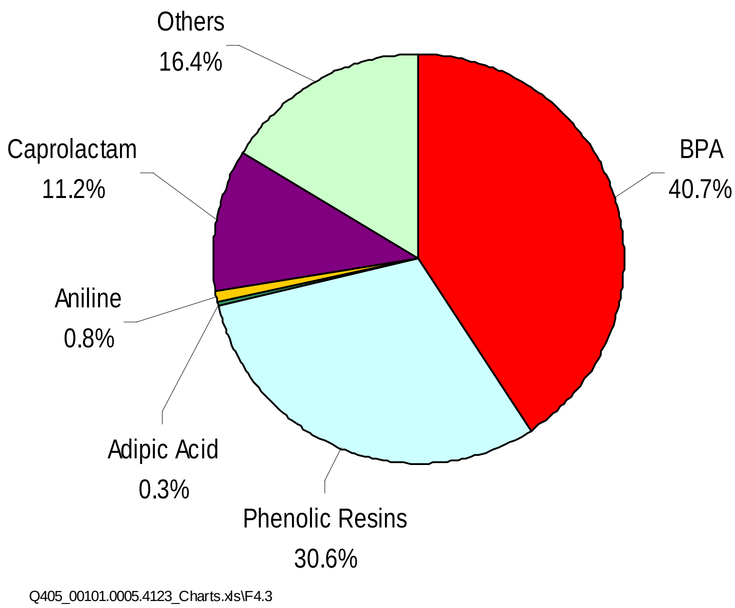
Various historical by-product pricing scenarios are evaluated in the report. However, historical data are of limited value in predicting future pricing, given the differing volumes and end use patterns for acetone and MEK. The virtue of the Shell process is that the modest increase in investment required to achieve the flexibility to alter the acetone/MEK ratio coming out of the phenol plant will likely pay dividends due to the ability to optimize phenol costs according to market conditions.

Commercial Analysis

Phenol

Figure 1 gives the breakout of global phenol demand by end-use. Bisphenol A (BPA) is the largest consumer of phenol (40.7 percent of the global demand in 2005) followed by phenolic resins (30.6 percent of the global demand). Regional distribution of phenol demand in 2005 was balanced with the Americas and Asia Pacific even at 34 percent and Europe/Middle East/Africa somewhat lower at 32 percent.

Figure 1
Global Phenol Demand by End-Use, 2005



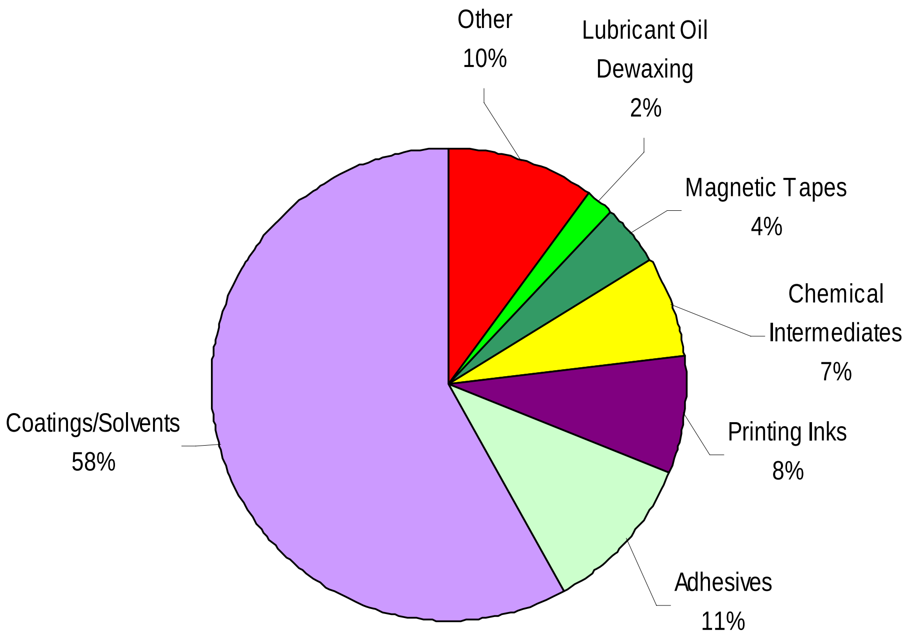
North America is forecast to continue to be the global supplier of a majority of the world's phenol. Western Europe, Eastern Europe, and Asia Pacific will continue to be the major importers of phenol. North America has 31 percent of global phenol capacity, compared to 27 percent for Western Europe and 29 percent for East Asia.

Methyl Ethyl Ketone (MEK)

Almost 75 percent of the global MEK capacity is concentrated in the three major regions (United States, Western Europe and Japan). However, capacity in the Asia Pacific region has increased substantially in the last three years, especially in China. Over half of the production capacity of MEK is in Asia, which is also the largest consumer of MEK. Most companies derive MEK from butylenes, which are hydrolyzed to sec-butyl alcohol. The alcohol is then dehydrogenated to form MEK.

The global demand for MEK is shown in Figure 2. Coatings and solvents continue to be the largest consumer of MEK, accounting for about 58 percent of the global MEK consumption.

Figure 2
Global MEK Demand, 2004



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