Abstract

Process Economics Program Report 37C

ACETIC ACID

(December 2001)

This report appraises the current commercially dominant methanol carbonylation technologies for acetic acid production based on the recent developments in catalyst technology. In addition, two alternate but comparatively newer technologies employing the oxidation of hydrocarbons (ethylene and ethane) are evaluated. The following technologies are dealt with:

- BP Cativa^{TM} technology.
- Celanese Acid Optimization (AO) technology.
- Showa Denko Single-step Ethylene Oxidation technology.
- SABIC (Saudi Basic Industries Corporation) Ethane Oxydehydrogenation technology.

BP's Cativa^{TM}, a methyl carbonylation technology, is an improved version of the original Monsanto's rhodium catalyzed acetic acid technology which BP inherited from Monsanto in 1986. Instead of rhodium, Cativa^{TM} employs BP's proprietary iridium (and iodides) based promoted catalyst. The new catalyst offers a higher reactivity, increased catalyst stability, reduced by-products and lower energy consumption in product purification as compared to original rhodium catalysts.

Celanese also originally licensed the acetic acid technology from Monsanto in the late 1970s. But now it is the sole owner. The AO technology is a result of a number of improvements and optimizations in the original Monsanto technology. AO technology is founded on proprietary rhodium (and iodide) based catalyst materials, which impart a high stability to the catalyst system permitting carbonylation at lower water concentrations. Some catalyst formulations use iridium in combination with rhodium. By-product formation is much reduced and optimized purification methodologies result in increased product purity. From the capital investment viewpoint, Celanese, as our estimates indicate, has a slightly higher capital intensity than that of BP.

SD's (Showa Denko's) ethylene route to acetic acid makes acetic acid production independent of methanol and carbon monoxide (CO). This process, which offers capability for a single-step ethylene conversion to acetic acid, is a more cost effective variance of the conventional two-step ethylene oxidation process (via acetaldehyde). The (palladium catalyzed) process is useful at small capacities to meet local requirement of acid. However, its economics are not comparable with those of methyl carbonylation technology.

SABIC's (molybdenum, vanadium and niobium/palladium/lanthanum catalyzed) ethane based route to acetic acid is another alternative technology for acetic acid which is being tested for commercialization. Like SD, this technology may offer cost effective means for acid production for regionalized demand. The technology has not been yet demonstrated even on a semi commercial scale and bears of all kinds uncertainties typical to a new process. Ethylene and CO_2 are

the major by-products. CO_2 may be an environmental concern if it does not find an end user. Ethylene and acetic acid production need to be balanced according to their demand.

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