Propylene oxide production pdf

A continuing trend in propylene oxide production has been to develop and market process routes that do not produce considerable co-products or that do not use chlorine-based chemistry, according to consultants Nexant ChemSystems. Propylene oxide (PO) is traditionally made by chlorohyrin and epoxy routes, but new technologies based on hydrogen peroxide or cumeno hydroperoxide have been marketed. A significant amount of PO capacity is based on the older chlorohyrine process, but this route suffers from environmental liabilities and has high capital costs. Propylene and chlorine in the presence of water are reacted to form propylene chlorohydriine, which is further reacted with sodium hydroxide or calcium hydroxide to obtain PO. These plants are often integrated with chlorine-akali plants that consume a large amount of energy to make chlorine and caustic soda. Extensive effluent treatment is required to cope with the large flow of diluted calcium chloride residues. An epoxy process that had been gaining popularity due to its superior economy was the propylene/styrene monomer (PO/SM) route. However, it has the potential co-production disadvantage of 2.25 tons of styrene for each tonne of PO. This may present difficulties in balancing markets for PO and styrene, leading to volatility in the economic performance of operations over time. Capital costs can also be relatively high. Several PO/SM factories were built by companies such as Repsol, Ellba (Shell/BASF) and LyondellBasell. In the PO/SM process, ethylbenzene is first reacted with oxygen to make ethylbenzene hydroperoxide and then with propylene to form PO. The co-product phenylmethylcarbinol is dehydrated to styrene. An alternative epoxy route uses isobutane that makes a tertiary-butyl alcohol co-product that can be converted into tertiary methyl butyl ether (MTBE). LyondellBasell employs this epoxidation technology. New technologies without co-products have now been developed. The first to be marketed was a cumene hydroperoxidation technology employed by Sumitomo at a 200,000-ton/year factory in Chiba, Japan. The process was later used in a 200,000-ton/year factory in its PetroRabigh joint venture with Saudi Aramco in Saudi Arabia. Cumene hydroperoxide is obtained by oxidation of cumene (made of benzene and propylene) with air. According to Nexant ChemSystems, by giving up oxygen to propylene, cumene hydroperoxide is converted into cumyl alcohol (also called dimethylbenzyl alcohol). Cumyl alcohol can be dehydrated to alpha-methssstyrene, which in turn can be hydrogenated back to the cumene for recycling. According to a Sumitomo patent, the stages of dehydration and hydrogenation can be combined into a single stage of hydrogenolysis. Several companies have developed to make PO from propylene and hydrogen peroxide. Nexant ChemSystems says the biggest attraction of the HPPO process is its apparent simplicity with a reaction and few by-products. Co-product water can be treated normally and discharged. Although reaction conditions are mild, the presence of water and possibly alcohol as a solvent can result in product loss for secondary ring opening reactions. Evonik (ex-Degussa) and German engineering contractor Uhde developed an HPPO process that was then licensed to South Korea's SKC. The first commercial-scale plant with a capacity of 100,000 tons/year using the HPPO process began in Ulsan in 2008. Dow Chemical acquired its hydrogen peroxide technology when it bought EniChem's polyurethane business in 2001. Meanwhile, BASF had been exploring hydrogen peroxide-based routes to PO since the mid-1990s. The companies began collaborating in 2003 to develop a joint process that was employed in a 300,000-ton/year joint venture in Antwerp, Belgium, which began in 2009. Dow with Sião Cement will also use the HPPO process in Thailand. Source: ChemSystems PERP Program, Propylene Oxide, January 2009 Published in August 2015Esto report consolidates and updates the technical and economic analyses of the Process Economics Program of propylene oxide (PO) manufacturing technologies from 1970 to the present. Po is mainly consumed as a comonomer in the production of polyether polyols, most of which are used to manufacture polyurethanes. PO-derived polyurethanes are applied to the manufacture of rigid and flexible foams, elastomers, adhesives, sealants, coatings and fibers. Low volume and non-hátane applications of PO include polyether polyether surfactants and demulsifiers; propylene glycol for defrosting, fiberglass and hydraulic fluids; Propylene oxide glycol ethers and carbonate solvents propylene; polyalkyleneglyccol fuel additives and lubricants; and several others. Almost half of the current global PO capacity uses processes based on propylene oxidation by organic hydroperoxides of ethylbenzyl hydroperoxide (EBHP) and tert-butyl hydroperoxide (TBHP), at about 27% and 15%, respectively. The EBHP and TBHP processes coproduce more tonnage of their by-products (styrene and t-butanol, respectively) than PO; however, despite concerns over the years, the markets for their co-products continue to support PO processes. The chlorohyrine route is disadvantaged for new plant start-ups in most locations due to its co-production of abundant saline wastewater, but still accounts for about 41% of the overall PO capacity. The environmental viability of a modern chlorohydin plant rests on its production scale, where large-scale plants can be fully integrated with blond/caustic plants. Lower volume commercial processes include hydroperoxidation using cumyl hydroperoxide as an oxidant, with 2% capacity and the newest HPPO processes using hydrogen peroxide, at 15% of global capacity. New mid- and large-scale start-ups or expansions have been announced using the HPPO and TBHP processes, with some small-scale plants announced announced chlorohynation. Technical descriptions and economic analyses are provided here for the following ten technologies, all of which use propylene as raw material:O LyondellBasell process for PO and alcohol t-butyl by hydroperoxidation using TBHPO Huntsman process for PO and t-butyl alcohol by hydroperoxidation using TBHPThe LyondellBasell process for PO and styrene by hydroperoxidation using EBHPO shell process for PO and styrene by hydroperoxidation using EBHPO process Sumitomo for PO by hydroperoxidation using cumyl hydroperoxide (CHP)The BASF-Dow process for PO by hydroperoxidation using hydrogen peroxide (HP)The Evonik-Uhde process for PO by hydroperoxidation using HPThe AIST-Nippon Shokubai, non-commercial process for PO by propylene reaction, O2, and H2 in the same reactorThe chlorhyrine process for PO by chlorination followed by treatment with calcium hydroxide derived from lemonThe chlorhydin process for PO by chlorination followed by treatment with sodium hydroxideElese and other past technologies , present and emerging for PO production are reviewed with a bibliography and abstracts for relevant patents since the 1950s. Industry status is updated, modern PO processes are summarized in terms of comparative economy and key process indicators (KPI) of capital intensity, energy intensity, carbon efficiency and carbon intensity. Finally, the iPEP Navigator PO tool is attached to the electronic version of this report. The iPEP Navigator interactive module provides a cost-effective snapshot for each process, allowing the user to select and compare the processes, units, and regions of interest. Previous PEP Consolidated ReportsCR001 - Wide Range Linear Alpha Olefin ProcessesCR002 - On Purpose Linear Alpha OlefinsCR004 - Oxo AlcoholsCR005 - On-Purpose Acetic Acid View Table of Contents (PDF) Propylene Oxide is the main raw material for obtaining propylene glycol and different types of polyurethanes. Propylene glycol is used in the production of unsaturated ester resin to create fiberglass plastic. Polyurethanes are used to obtain soft foam for the furniture and automotive industries, as well as rigid foams for the production of electrical appliances and thermal insulation. The total world production of propylene oxide in 2012 was more than 10 million tons per year. Global demand for propylene oxide increases by 4 to 5% each year. Himtek Engineering has developed a completely new technology, without analogues in Russia, to obtain propylene oxide by propylene direct epoxy oxide with hydrogen peroxide (HPPO technology). The process is conducted at a pressure of 1.5 MPa and temperature of up to 60 °C in a fixed heterogenous titanium silicate catalyst (TS-1/SiO2) in a cascade of adiabatic reactors of the two-column type with a liquid flow of film in a methanol medium. The total conversion of peroxide from is 98.6%, and the selectivity of propylene oxide for hydrogen peroxide is 92.3%. Methoxypropanols and propylene glycol are by-products. Byproducts. the separation of the oxide is carried out by extractive rectification. Propylene oxide production consists of the following steps: propylene oxide synthesis. Propylene distillation. Separation of propylene oxide. Methanol distillation and wastewater treatment. Low temperature and pressure. Low production of by-products. Low material and energy costs. Safety of the reactor unit, with an effective chemical reaction thermal abstraction. Ecologically correct. The main innovation of the technology concerns solutions for the organization of the process and is designed to save energy resources and simplify the design of the reactor unit. Design.