3.PROCESS DESCRIPTION

(a) Various processes:

In early 1960's alkyl benzene derived from propylene tetramer had been the work-horse of the detergent industry. Detergents derived from PT benzene caused considerable difficulties in sewage systems. The bacterial flora normally present in sewage was unable to cope with the steadily increasing amounts of detergents based on PT benzene present in town effluent. Huge manses of foam formed on top of sewage plants. This detergents form not only caused aesthetic problems in rivers and in town water, but also presented biological degradation of other sewage components from causing health hazards. Later this PT chain was replaced by a straight chain paraffinic or olefinic hydrocarbon which in sewage was attacked and destroyed much more quickly by bacterial flora. In the process linear alkyl benzene is taken as raw material. The detergents produced from these are "biologically soft".

Sulfonation can be carried out using oleum, liquid sulphur trioxide, sulphamic acid. Sulphamic acid is only suitable for detergent raw materials where an OH group is present. Sulfonation using sulphur trioxide is high cost process. Also availability and maintenance or handling of sulphur trioxide is difficult. In the process oleum is taken. Oleum sulfonation is mainly used for the sulfonation of alkyl benzene. This process is cheaper comparing to other and commonly used in detergent industry.

(b) Process description:

In the process alkyl benzene [$C_{12}H_{25}C_6H_5$] which has straight chain hydrocarbons (straight chain ∝ - olefine) is taken as the raw material. (LAB) The alkyl benzenes are mobile liquids which can readily be transported to the detergent manufacturer, in drums or in bulk. 20% oleum is used for the sulfonation. Oleum can be handled in mild steel. This process is carried out as continuous operation. It is necessary to use a large excess of acid (1.1 times AB) to maintain a sufficiently high acid concentration to carry the reaction near enough to completion, cooling is necessary to keep the temperature of the reaction mixture at 30C. This is done using an heat exchanger.

Alkyl benzene is fed continuously to the sulfonator. Sulfonation product is recirculated through the heat exchanger by a centrifugal pump. Sulfonation kettle is equipped with a mixer or agitator. Oleum is charged at the pump inlet. The reaction product is continuously bled off to the digestor. Digestor is used to ensure the completion of the reaction. At this point the concentration of sulphuric acid has deceased. Approximately 98 percent of the hydrocarbon charged in sulfonated. Both sulfonator and digestor are maintained at 30°C.

Next acid mixture is diluted with water in the separator.In the separator it is usual to add 10% of water to the acid reaction mixture. Layer separation occurs. Care must be taken to avoid the development of high a temperature as the water is added. A lower layer of black H_2SO_4 and an upper layer of sulphonic acid, which contains at about 5-6% H_2SO_4 separate. The spent acid whose concentration is around 78% is removed. It can be removed continuously by means of centrifugal pump. Disposal of the spent acid may present problems. Sometimes it is neutralized with caustic soda, or sodium carbonate to produce a sodium sulphate which is useful in some NSD powder slurries. Product loss by solution in the spent acid is negligible.

The sulfuric acid is neutralized with 20% caustic soda solution to a pH of 7.5-8 at a temperature of about 55°C. Neutralization of acid reaction mixture gives

slurry containing sodium sulphate and sodium sulfonate.Since the reaction is exothermic neutralizer requires some form of jacketed cooling.

The slurry from the neutraliser is passed into the spray drier. Droplets of liquid are brought into contact with hot gas in some form of chamber, where they dry rapidly to produce a powder. The powder from the drier contains 80-85% of active surfactant, the rest being sodium sulphate and water.

This material has then only to be diluted to obtain liquid products etc. or be mixed with suitable builders to provide products ready to be marketed.