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Synthesis of surfactants out of perfluoroalkanesulphofluorides

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Introduction

Fluorine containing surfactants are very effective agents, greatly lowering surface tension when their content in solution is small, surfactants are characterized by high stability, and perfluorinated derivatives of alkanesulpho-acids can form stable foam even in the presence of strong oxidizer like chromic or sulphuric acid, they are also high temperature resistant [1,2]. Due to these characteristics surfactants are used for fire-extinguishing compositions, for electrochemical metal plating tanks and at electrochemical refining of nickel and chrome.

Perfluoroctanesulphofluoride, which is a source material for these surfactants synthesis, was synthesized using electrochemical fluorination method in anhydrous hydrogen fluoride medium.

The application of such surfactants in chroming tanks almost completely excludes loss of chromic anhydride; improves surface quality, making it plane, durable, porousless on the details with different configuration; current yield increases in 5%, foaming near cathode is missing.

An addition of chemical into nickel electrorefining electrolysis tank in the quantity of 20-40 mg/l

- Greatly lowers the nickel dispersion of nickel; the level of nickel aerosols meets maximum permissible concentration;
- Stabilizes the electrorefining process
- Improves the nickel quality
- The yield of nickel according to current is 100%.

These surfactants are effective chemicals for destroying of radio-active elements complexes in foul water.

Surfactants synthesis methods

Crude material, isolated from anhydrous hydrogen fluoride and obtained by electrochemical fluorination method in anhydrous hydrogen fluoride was put to rectification, where perfluoroctanesulphofluoride was isolated with purity 97,0%- 99,0%. The crude material was refined using packed column, filled with glass spirals of length and diameter equal to 2 mm, column height was 42 cm, column diameter was 18 mm. The process was carried out at cube temperature ranging from 70 to 110 ^{o}C, the residual pressure was changing in the range from 65 till19 mm Hg. The product was analyzed using gas-liquid chromatography method. This analysis was carried out at Russian apparatus "Tsvet-100" equipped with

thermal conductivity detector, at column, filled with silochrom -80 with 20%α,tris-betacyanacetophenone.

Monomethylethanolamine (MMEA) and monoethylethanolamine (MEEA) were also purified using rectification method in vacuum at packed column height 42 cm, diameter 18 mm. Control was carried out according to refractivity index, which is 1,4390 and 1,4400 at 20^{o}C for MMEA and MEEA respectively.

Synthesis of surfactants.

Surfactants, containing different functional groups, are obtained by interaction of perfluoroalkanesulphofluorides and nucleophilic reagents. As on the one hand, the most stable are sulpho acids amides, and, as we had stated before, on the other sulpho-acid ethanolamine derivatives are well soluble both in acid and alkaline mediums it was advantageous to synthesize and study the properties of surfactants, containing alkylethanolamines. Monomethylethanolamine and monoethylethanolamine were used as nucleophilic reagents. The production of these chemicals is set in Russian Federation.

The process of perfluoroctanesulpho-acid alkylethanolamine derivatives synthesis can be described by the following equation:

where R is - CH_3, - C_2H_5.

The measurement of aqueous solutions (0,2-0,25%) of present surfactants, which were synthesized out of perfluoroalkanesulphofluoride showed the coefficient of surface tension, σ = 17 -19 mN/m., that is a rather high index. For comparison, the surface tension of chemical named "chromine", which was used in industry before , was about 33 mN/m. The surface tension was measured by stalagmometer.

References

1. Organic Electrochemistry, v. 2, p 781-788, Moscow, Chemistry, 1988;
2. Abe T. Nagase S. Chapter 1. Electrochemical fluorination (Simons process) as a route to perfluorinated organic compounds of industrial interest. 19-43, (1982).