

Modification of catalyst of the direct chlorination of ethylene into 1,2-dichloroethane

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Abstract – new improved catalytic system for the process of the direct chlorination of the ethylene is proposed and investigated. New catalytic system increases productivity of the reactive volume and allows to decrease negative influence of production on the environment.

Keywords: catalytic system

Introduction

As it is known, as catalyst for the reaction of direct chlorination of ethylene into 1,2-dichloroethane (DCE) is used chloride of iron (III), that is promoted by sodium chloride in concentrations of 1000 ppm and 20 ppm respectively, meaning at ratio 1:20. Under such conditions amount of created DCE is 98,2-99,4%, and as by-products are created vinyl chloride, four chloro carbon, 3-chloro ethane, 3-chloro ethylene and others.

During preparation of catalytic system [FeCl₃-NaCl] certain attention should be paid to the size of sodium chloride particles ($d \leq 60$ mcm), because its solubility in DCE is low even under such dispersion of sodium chloride and time needed for creation of solution is 2 hours. It is also worth mentioning that catalytic complex breaks into components under temperatures lower than 50 °C leading to decrease in activity of catalytic system.

Results and discussion

We have prepared mixtures of sodium chloride with addition of 10% sodium salt of perfluorosulfonic acid, as a stabilizer of complex (modifier) of the following fraction composition:

Table 1

Fraction composition of the prepared mixtures.

Date	Moisture, %	Fraction composition,%			
		0,2 mm	0,09 mm	0,045 mm	Less than 0,045 mm
27.07.2018	0,15	46,1	46,9	6,5	0,3
12.11.2018	0,16	59,3	24,5	14,9	0,4
12.03.2019	0,12	1,0	2,2	89,3	7,5

After dissolution of iron chloride in reactor was added needed amount of sodium chloride with modifier and after 2 hour mixing catalytic solution was transferred to the reactor of direct chlorination of ethylene.

According to the data of the long-term experiments concentration of sodium ions in the reactor of direct chlorination was increasing during all period of experiment from 8 ppm to 33 ppm, and after stoppage of activator addition it decreased to 10-15 ppm.

Analysis of the ratio of ions [sodium:iron] showed that it also increased during experiments and reached previously set indexes.

Symbiotic behavior of change of concentrations of ions of iron and sodium during constant increase of their ratio proves positive influence of modifier on catalytic complex.

Analysis of pureness of DCE in reactor of direct chlorination shows its increase from 98,9% (2 January) to 99,3%.

Conclusion

Thus modification of the catalyst of direct chlorination of ethylene allows to increase selectivity of creation of 1,2 – dychloro ethane and decrease amounts of by-product 3-chloro ethane, that decreases amount of chloro organic compounds on the burning stage and leads to increase of ecological safety of the production.