ISGC 2019
May 13th - 17th

N°456 / OC
TOPIC(s) : Industrial chemistry / Alternative technologies

Green Production Technology of Cyclohexanone

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PURPOSE OF THE ABSTRACT

1 Introduction

Cyclohexanone is an important organic chemical raw material and is the main intermediate for the manufacture of ?-caprolactam and adipic acid. It is also widely used as a solvent.

Industrially, the production processes of cyclohexanone mainly include cyclohexane oxidation, phenol hydrogenation and cyclohexene hydration. Among the above processes, the application of the cyclohexane oxidation is most common.

2 Production technology of cyclohexanone

The cyclohexane oxidation process uses an oxidizing agent (generally air) to oxidize cyclohexane to cyclohexyl hydroperoxide, and cyclohexyl hydroperoxide decomposes to a mixture of cyclohexanol and cyclohexanone (KA oil), and cyclohexanone obtained by dehydrogenation of cyclohexanol. The disadvantages of this process are: (1) the conversion of cyclohexane is low, only 3 to 5%, the yield of cyclohexanone is less than 80%; (2) a large amount of refractory waste alkali liquor is produced in the production process, so it is environment unfriendly; (3) intrinsic safety issues with oxidation processes.

The phenol hydrogenation process is a relatively clean cyclohexanone production route, and the yield of cyclohexanone can reach 90% to 95%, which has the advantages of short process flow and high product purity. However, this process requires the vaporization of phenol and methanol, so the energy consumption is high; and the industrial application of the process is limited due to the shortage of phenol raw materials. In the 1980s, Asahi Kasei developed a process for the cyclohexene hydration to cyclohexanol, which was industrialized in 1990. The hydration process has high reaction selectivity, almost no waste discharge in the process, and is highly competitive. However, this process has two shortcomings: (1) the conversion of cyclohexene is less than 10%, a large amount of cyclohexene is circulated in the system; (2) the hydration reaction requires high purity cyclohexene. Therefore, the device consumes a lot of energy.

3 Cyclohexene esterification process

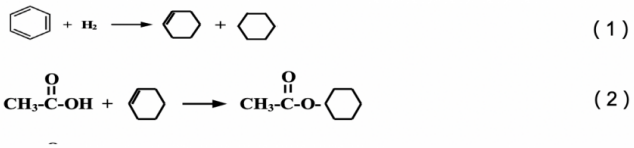
Research institute of petroleum processing (RIPP) of Sinopec has developed a green production technology to productcyclohexanone. The process uses benzene selective hydrogenation + benzene extraction + cyclohexene esterification + cyclohexyl acetate hydrogenation + cyclohexanol dehydrogenation process to produce cyclohexanone (scheme-1). In the benzene selective hydrogenation unit, benzene and hydrogen react to form cyclohexene and cyclohexane; the reaction product (benzene, cyclohexene, cyclohexane) is separated into benzene?and the mixture of cyclohexene and cyclohexane after the benzene extraction unit; in the esterification unit, the cyclohexene of the mixture and acetic acid react to form cyclohexyl acetate, through the fixed bed reaction + catalytic distillation reaction process, cyclohexene can be 100% conversion, at the same time to achieve cyclohexane separation; the cyclohexyl acetate is hydrogenated in the ester hydrogenation unit to obtain cyclohexanol and ethanol; the cyclohexanol is dehydrogenated in the dehydrogenation unit to obtain

cyclohexanone.

4 Conclusion

The green production technology of cyclohexanone technology developed by RIPP-SINOPEC, can achieve green production of cyclohexanone, which has the characteristics of high product yield, less wastes discharge?low energy consumption and good technical economy. The technology has completed pilot plant verification and the process package design ?200kt/a?, and will realize industrial production in recent years.

FIGURES



(1)

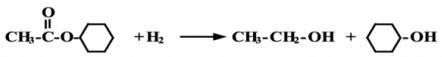
(2)

FIGURE 1

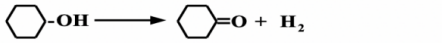
Scheme 1

Compared with the existing cyclohexanone production technology, the cyclohexene esterification to cyclohexanone process has the following advantages:

1) The product yield is greater than 98%, and the wastes in the production process
are rarely discharged



(3)



(4)

FIGURE 2

Scheme 1

KEYWORDS

Cyclohexanone | Esterification | Production | Technology

BIBLIOGRAPHY