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## The Green Production Process of caprolactam with Vapor-Phase Beckmann Rearrangement

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### PURPOSE OF THE ABSTRACT

#### 1. Introduction

Vapor-phase Beckmann rearrangement is a green, free-ammonium sulfate caprolactam production process. With the increasing demand for caprolactam, this process has been widely concerned. The existing liquid-phase method, as shown in Eq.(1), uses sulfuric acid as a catalyst, and produces about 1.5 tons of ammonium sulfate per ton of caprolactam, which will be a great burden of caprolactam enterprises in the future. Compared with the existing processes, the vapor-phase rearrangement process, as shown in Eq.(2), has the advantages of low equipment corrosion, low waste water discharge, high product quality, safe and stable operation, and thus has a broad market development prospect as a new generation of caprolactam production process.

#### 2. The production process of caprolactam with vapor-phase Beckmann rearrangement

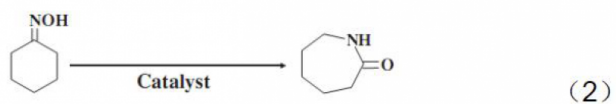
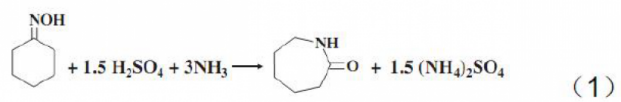
The process consists of vapor-phase Beckmann rearrangement reaction unit and crystallization refining unit. The determined process conditions and process flow are quite different from those of the existing HPO process.

The vapor-phase Beckmann rearrangement process is a gas phase reaction process, which requires cyclohexanone oxime to participate in the reaction with gas phase. However, due to its heat-sensitive characteristics, its vaporization problem is the primary problem in the development of vapor-phase Beckmann rearrangement process. Secondly, since the reaction proceeds at a high temperature, the product distribution characteristics determine that the refining process requires a crystallization method with high-efficiency separation method. In the process of crystallization process development, the high quality product was obtained. RIPP-SINOPEC relies on 800 tons/year cyclohexanone oxime vapor-phase Beckmann rearrangement pilot equipment device to solve lot problems after years of process development. A total of 5000 hours of experimental investigation was completed in this device. Time-on-stream of the catalyst was greater than 700 hours, the conversion of cyclohexanone oxime was greater than 99.9%, and the selectivity of caprolactam was greater than 96.5%. Meanwhile, the high quality caprolactam was produced with crystallization refining in this pilot plant. At present, the process has already been industrialized and promoted.

#### 3. Conclusion

Vapor-phase Beckmann rearrangement process of produced caprolactam was developed by RIPP-SINOPEC, which is a green process and high atom economic. The technology has completed pilot plant verification and will realize industrial production in recent years.

## FIGURES



### FIGURE 1

reaction equation

Fig 1

### FIGURE 2

## KEYWORDS

## BIBLIOGRAPHY