



METHOD FOR THE JOINT PRODUCTION OF A CYCLIC LACTAM AND A CYCLIC
AMINE

Specification

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The present invention relates to a process for coproducing a cyclic lactam and a cyclic amine by reacting an aliphatic alpha, omega-diamine with water in the gas phase in the presence of a heterogeneous catalyst.

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Cyclic lactams, such as caprolactam, are known starting materials for the manufacture of industrially important plastics such as nylon. Cyclic amines, such as azepan, are widely used as intermediates for preparing pharmaceuticals, agrochemicals,

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corrosion inhibitors for nonferrous metals, vulcanization accelerants and as ingredients of textile assistants and sizes, antistats and finishes and also crosslinking agents for resins.

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GB 1 358 862 (1974) discloses the preparation of lactams from specifically five- and more highly membered azacycloalkanes or from diamines and water over solid hydrogenation catalysts in the liquid phase at 150-400°C.

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It is reported that piperidine/H₂O/NH₃ in a weight ratio of 1/10/9 (molar ratio about 1/47/45) converts at 300°C over Ra-Ni, Pt/C and Ru/Al₂O₃ into piperidone with yields of around 50% in the course of 2-3 hours. In contrast, azepan ("hexamethyleneimine", HMI)/H₂O/NH₃ likewise in a weight ratio of 1/10/9 converts at 270°C over Ra-Ni into only 17.6% of the theoretical amount of

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caprolactam in the course of 5 hours.

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When the diamine used is hexamethylenediamine ("HMD"), the yield of caprolactam is at 10.7% even lower than from azepan and hence far below the industrially required level; azepan is evidently not formed in this reaction. In addition, large amounts of NH₃ have to be used.

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Processes for preparing azacycloalkanes from diamines, such as azepan from HMD, without the coproduction of cyclic lactams are common knowledge.

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For instance, CA-A 920 606 describes the conversion of HMD into azepan over cobalt and nickel catalysts (Ra type and also on supports such as SiO₂, Al₂O₃) in the presence of H₂ at HMD/H₂ = 1:2-70, 150-250°C and 1-20 bar.



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We claim:

1. The process for coproducing a cyclic lactam and a cyclic amine by reacting an aliphatic alpha, omega-diamine selected from the group consisting of 1,4-diaminobutane, 1,5-diaminopentane, 1,6-diaminohexane, 1,7-diaminoheptane and mixtures thereof with water in the gas phase in the presence of a heterogeneous catalyst by using a molar ratio of water to the aliphatic alpha, omega-diamine greater than 1, a temperature within the range from 150 to 600°C and a heterogeneous catalyst comprising

- (a) a dehydrogenating component and
- (b) an acidic and/or amphoteric component,
- (c) the dehydrogenating component in the heterogeneous catalyst being a metal selected from the group consisting of Cu, Ag, Ni, Co, Rh, Ru, Ir, Os and Re.

2. The process of claim 1, wherein hexamethylenediamine is used as aliphatic alpha, omega-diamine to obtain caprolactam as cyclic lactam and azepan as cyclic amine.

3. The process of claim 1, wherein the molar ratio of water to the aliphatic alpha, omega-diamine is within the range from 3 to 25.

4. The process of claim 1, wherein the dehydrogenating component in the heterogeneous catalyst is a metal selected from the group consisting of Cu, Co and Ru.

5. The process of claim 1, wherein the cyclic amine obtained as product is mixed into the aliphatic alpha, omega-diamine.