POLYOLEFIN AND CHEMICAL CATALYSTS

ALBEMARLE®

KDC-6 – For optimal methylamine productivity during your catalyst life cycle

Albemarle KDC-6 catalyst is the state-of-the-art commercial choice used in many methylamine production units around the world. Compared with its predecessors, KDC-6 offers superior activity, stability, strength and overall productivity. Low carbon formation on the catalyst prevents particle swelling, which, combined with the catalyst's high initial strength, means that slow pressure drop build-up over time during the catalyst cycle is not seen. This gives KDC-6 its long cycle time and high productivity over the run.

Methylamine production

The reaction of ammonia and methanol in the presence of a solid acid catalyst forms a mixture of mono-, di- and trimethylamine (MMA, DMA and TMA, respectively). They are important intermediates in the manufacture of various industrial chemicals. The major outlets for the respective amines include

- **MMA:** chemicals (n-methyl-2-pyrrolidone and n-methyl-diethanolamine), pesticides and explosives
- **DMA:** chemicals (dimethylformamide and dimethylacetamide), water treatment chemicals and detergents
- **TMA:** animal food additives (choline chloride).

Globally, the demand for the different methylamines shows large regional variations. For instance, in Europe the consumption ratio of MMA:DMA:TMA is 1:3:1, whereas in Asia the ratio can be 1:8:1. This ratio is subject to change owing to the increasing number of outlets for MMA, for example, n-methyl-2-pyrrolidone, a solvent.

Methylamines are synthesized from methanol and excess ammonia in a gas-phase reaction at 300–500°C and at elevated pressure in the presence of a solid acid catalyst to form an equilibrium mixture of roughly 25:30:45 MMA:DMA:TMA. With the market favoring DMA production, large quantities of MMA and TMA have to be recycled to maximize the production of DMA. This is the basis for the well-known Leonard process, a schematic for which is shown in Figure 1.

In the Leonard process, fresh methanol and ammonia feed are combined with recycled ammonia and methylamines (mainly MMA and TMA) and are fed to a reactor containing a solid acid catalyst. The amorphous silica alumina catalysts produced by Albemarle are those most commonly used in the methylamine production process. These catalysts are highly active and stable but have no specific product selectivity. Therefore, the equilibrium mixture of MMA, DMA and TMA is obtained, provided the process conditions are optimized. The mixture is then purified to a high level (see Figure 1). In modern set-ups, a methanol recovery facility can also be added.

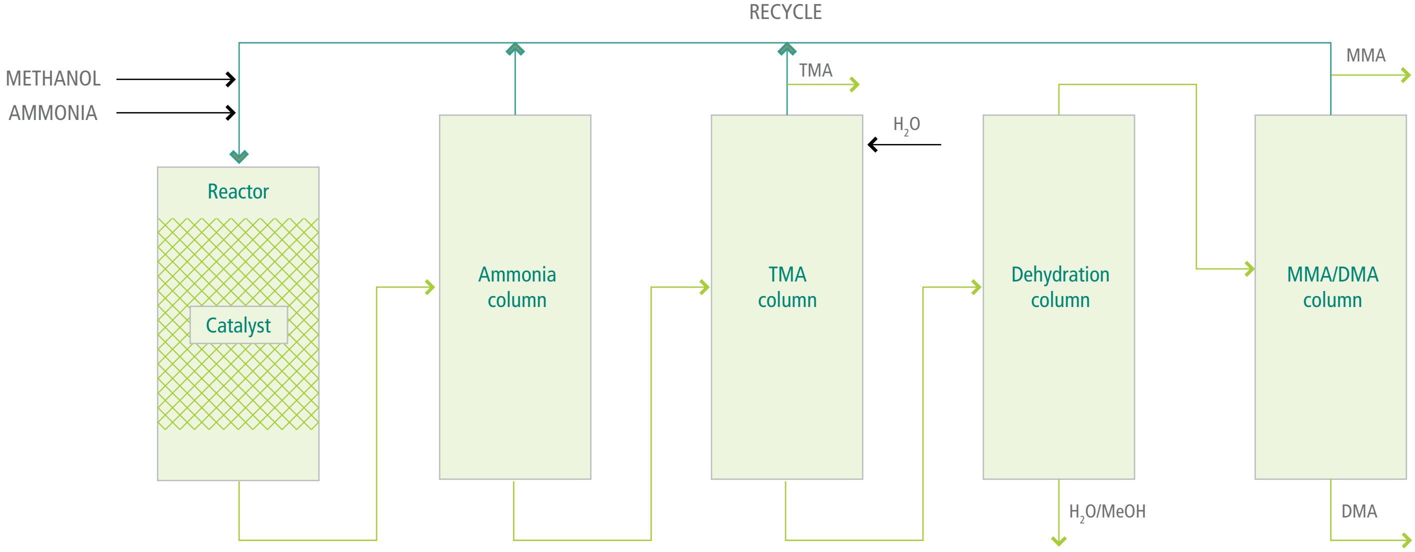

Figure 1: Process schematic for methylamine production.

Catalysts for methylamine production

Currently, all the catalysts used for methylamine production yield the equilibrium composition of methylamines. Zeolites with narrow pores show enhanced selectivity for DMA. However, they have lower activity and stability than amorphous catalysts. The Nitto process for production of MMA and DMA is based on technology using zeolites. However, sizeable quantities of TMA are formed and therefore this process requires an amorphous silica alumina catalyst (in a separate reactor) to disproportionate TMA.

Historically, Albemarle has continuously improved the activity and stability of its catalysts for methylamine production, and now KDC-6 catalyst is widely applied in methylamine production units around the world. Figure 2 shows the historical development of the activity of various Albemarle methylamine catalysts. Table 1 shows the typical productivities and lives of some of the catalysts.

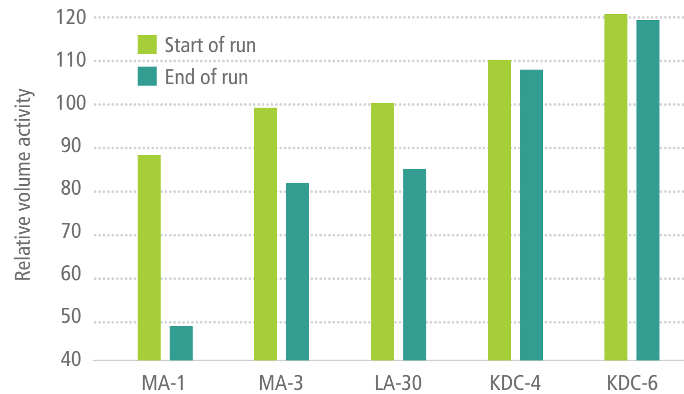

Figure 2: Activity levels of successive generations of Albemarle methylamine catalysts.

	LA-30	KDC-4	KDC-6
Productivity, ton methanol/ton catalyst	3,500–5,000	5,000–8,000	10,000–15,000
Life, months	8–12	12–28	18–36

Table 1: Productivity (typical range, depending on conditions) and life of successive Albemarle catalyst generations.

Typical product properties	↘
Catalyst name	KDC-6
Application	Methylamine production
SiO_2, %db	21
Al_2O_3, %db	Balance
Size, mm	5
Shape	Pellet
Estimated reactor density, kg/m^3	470–520
Surface area, m^2/g	350
Average side crushing strength, lb	Minimum 30
Packaging	210-L drum, 100 kg per drum

↘ For more information on this or other Albemarle products and technologies, please contact your Albemarle representative.

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