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MDI Process Update

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Abstract

Isocyanates are a major ingredient for the production of polyurethane products that are formed by the reactive polymerization of isocyanates with polyols. A long and difficult search for a reasonable economic pathway to produce isocyanates by vapor-phase phosgenation of diphenylmethane diamine (MDA) in place of liquid-phase phosgenation of MDA has been developed and commercialized since our last report on isocyanates (PEP Report 1E) was published in August 1992.

In this review, we investigate large-scale, single-train integrated technology and economics for the production of methylene diphenyl diisocyanate (MDI), including condensation of aniline with formaldehyde to produce MDA, production of phosgene from carbon monoxide and chlorine, gas-phase phosgenation of MDA to produce crude MDI, and separation/recovery of MDI products. The key gas-phase phosgenation step produces isocyanates from MDA at high pressure and temperature, enabling a significant shortening of residence time in the reactor. The rate determining step is the dissociation of the polymeric MDA–carbonyl chloride intermediate into polymeric MDI and HCl followed by HCl removal.

A summary of the process economics for the production of 373 million lbs/yr of crude MDI and 336 million lbs/yr of polymeric MDI (PMDI) and 37 million lbs/yr of pure MDI for continuous vapor-phase isocyanate production shows that on a US Gulf Coast basis, the world-scale, single-train, integrated vapor-phase technology–based plant will meet plant gate costs. On the same basis, a world-scale, dual-train plant approximately will meet net production costs. With lower capital and manufacturing costs, for example in China, manufacturing operations would likely be profitable.
# Contents

1. **Introduction** 6  
2. **Summary** 8  
   - Markets  8  
   - Technology  9  
   - Economics  9  
3. **Industry status** 11  
4. **Technology review** 17  
   - Gas-phase technology  17  
   - Phosgenation  17  
   - Absorption of HCl gas  18  
   - Use in industrial-scale plants  20  
5. **Chemistry** 21  
   - Aniline condensation  21  
   - Phosgene production  23  
   - Polyamine phosgenation  23  
6. **Review of processes** 25  
   - Aniline condensation  27  
   - Phosgene generation  29  
   - Polyamine phosgenation  35  
   - Heating/superheating of vapor-phase phosgenation reaction feedstocks  36  
   - Vapor-phase phosgenation  37  
   - Phosgenation reactor offgas treatment  37  
   - Condensed offgas scrubbing  39  
   - Product recovery  43  
   - Recovery of HCl  45  
   - Crude product recovery  48  
7. **Process description** 50  
   - MDI formation by the phosgenation of MDA  51  
   - Aniline condensation (Section 100)  51  
   - Water treatment (Section 200)  51  
   - Phosgene generation (Section 300)  51  
   - Polyamine phosgenation (Section 400)  55  
   - HCl recovery (Section 500)  57  
   - Final product recovery (Section 600)  62  
   - Separation of MDI from PMDI  67  
8. **Process discussion** 68  
   - Aniline condensation  68  
   - Polyamine phosgenation  68  
   - Waste treatment  69  
   - Materials of construction  70  
9. **Cost estimates** 72  
   - PMDI formation by the phosgenation of PMDA  72  
   - Capital costs  72  
   - Production costs  72  

**Appendix A—Cited references** 78  
**Appendix B—Process flow diagrams** 81
Tables

Table 2.1 Process economics summary for vapor-phase phosgenation and production of MDI 10
Table 6.1 Effects of process operating variables on product distribution 28
Table 6.2 Effects of process operating parameter variances 42
Table 6.3 Composition of main MDI products 44
Table 6.4 Composition of commercial MDI product mixtures 45
Table 7.1 PMDI formation by the phosgenation of PMDA—Design basis and assumptions 50
Table 7.2 MDI production by vapor-phase phosgenation of MDA—Stream flows 58
Table 7.3 MDI production by vapor-phase phosgenation of MDA—Major equipment 63
Table 7.4 MDI production by vapor-phase phosgenation of MDA—Utilities summary 66
Table 8.1 MDI feedstocks for production of commercial MDI mixtures 69
Table 8.2 PMDI/MDI integrated production waste streams 70
Table 9.1 MDI production by vapor-phase phosgenation of MDA—Total capital investment 74
Table 9.2 MDI production by vapor-phase phosgenation of MDA—Total capital investment by section 74
Table 9.3 MDI production by vapor-phase phosgenation of MDA—Production costs 76

Figures

Figure 3.1 World methylene diphenyl diisocyanate (MDI) supply and demand 11
Figure 3.2 World methylene diphenyl diisocyanate (MDI) demand by end use 12
Figure 3.3 World methylene diphenyl diisocyanate (MDI) market share by end use application 13
Figure 3.4 World methylene diphenyl diisocyanate (MDI) demand by region 14
Figure 3.5 Total MDI production capacity by regional location 14
Figure 3.6 Top 10 global MDI producer capacities 15
Figure 4.1 Isothermal absorption of HCl gas 18
Figure 4.2 Adiabatic absorption of HCl gas 19
Figure 5.1 Typical reaction intermediates formed during condensation of aniline and formaldehyde 22
Figure 5.2 Unconverted by-products from the reaction of aniline and formaldehyde 23
Figure 5.3 Polymethylene polyphenyl isocyanate (polymeric MDI) 24
Figure 6.1 MDA and polymethylene polyphenyl isocyanate (polymeric MDI) 25
Figure 6.2 Integrated process to produce MDI and coproducts 26
Figure 6.3 Process for production of PMDA by condensation of aniline with formaldehyde 26
Figure 6.4 Basic tubular phosgene synthesis reactor 30
Figure 6.5 Two-zone phosgene synthesis reactor 31
Figure 6.6 Two close-coupled tubular phosgene synthesis reactors in series 32
Figure 6.7 Phosgenation using high-purity CO feedstock 33
Figure 6.8 Percent phosgene dissociation based on the calculated thermal dissociation of phosgene at equilibrium as a function of temperature 34
Figure 6.9 Time dependence of the approach of the phosgene reaction dissociation to equilibrium 35
Figure 6.10 Generalized integrated BFD for production of crude MDI by vapor-phase phosgenation 36
Figure 6.11 Phosgenation reactor product offgas quench operation 38
Figure 6.12 Quench product vapor-phase condensation process to recover monochlorobenzene solvent for recycle 39
Figure 6.13 Formation of urea side product from reaction of MDA and MDI 40
Figure 6.14 Formation of urea side product from reaction of MDA and MDI 41
Figure 6.15 Special process for purification of HCl offgases from vapor-phase phosgenation 47
Figure 6.16 Enhanced method for purifying HCl offgases from vapor-phase phosgenation 48
Figure 7.1 MDI formation by vapor-phase phosgenation of MDA 82