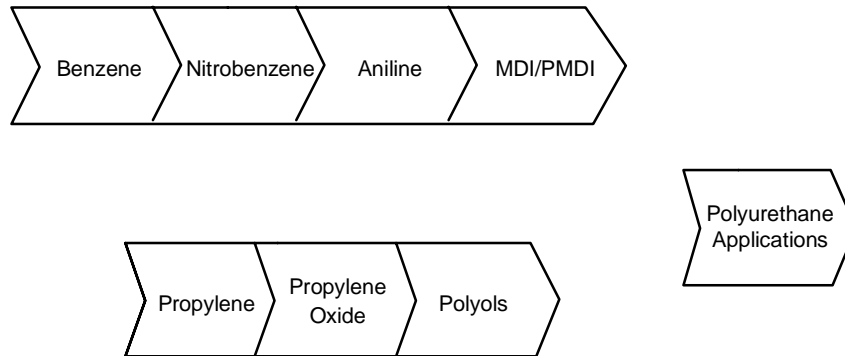


**TDI/MDI (98/99S8)**

The value chains for MDI based polyurethanes are pictured below. As can be seen there are two distinct value chains – one based on the sequence of reaction chemistries used to make MDP/PMDI from benzene, while the other chain takes propylene to polyols. Mixing and matching MDI/PMDI and various polyols allows suppliers to offer a range of polyurethane based systems for solving specific application problems.

The aromatic based chain starts with one of the key petrochemical building blocks, benzene. About two thirds of all MDI producers are back integrated as far back in the chain as benzene. The next link in the value chain is nitrobenzene. Nitration chemistry can be hazardous and not all producers opt to be in this part of the value chain and prefer to buy their nitrobenzene on the merchant market. For example, in the U.S., Dow and Bayer, two of the largest and most experienced companies in the polyurethane business, rely on merchant market suppliers DuPont and First Chemical. On the other hand, Bayer is self sufficient in nitrobenzene in its German plant. BASF and Huntsman (ICI) produce their own nitrobenzene.

**MDI/PMDI BASED POLYURETHANE VALUE CHAIN**



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Conversion of nitrobenzene to aniline is the next step in the MDI value chain. All MDI producers are all self sufficient in this stage of the chain with the exception of Dow. Bayer reportedly makes small quantities of aniline, but buys most of its aniline requirement from merchant suppliers. Other merchant suppliers of aniline are DuPont, First Chemical and

Aristech. Aristech makes aniline via ammonolysis of phenol. The table below shows the extent of integration for MDI producers.

TABLE IV.D.1  
MDI BASED POLYURETHANE VALUE CHAIN PARTICIPATION

Isocyanate Value Chain Participation				Region/ Company	Polyol Value Chain Participation		
Benzene	Nitrobenzene	Aniline	MDI/PMDI		Propylene	PO	Polyols
				United States			
				BASF			
				Bayer			
				Dow			
				Huntsman (ICI)			
				DuPont			
				Aristech			
				First Chemical			
				W. Europe			
				BASF			
				Bayer			
				Dow			
				Enichem			
				Huntsman (ICI)			
				Japan			
				Dow /Mistubishi			
				Mitsui			
				Nippon PU			
				Sumitomo/Bayer			
				Takeda BASF			

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This new report by Chem Systems examines the chemistry, process technology, production economics, markets and producer integration issues for the MDI and TDI business.