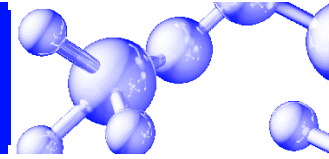


Melamine Technology and Feasibility

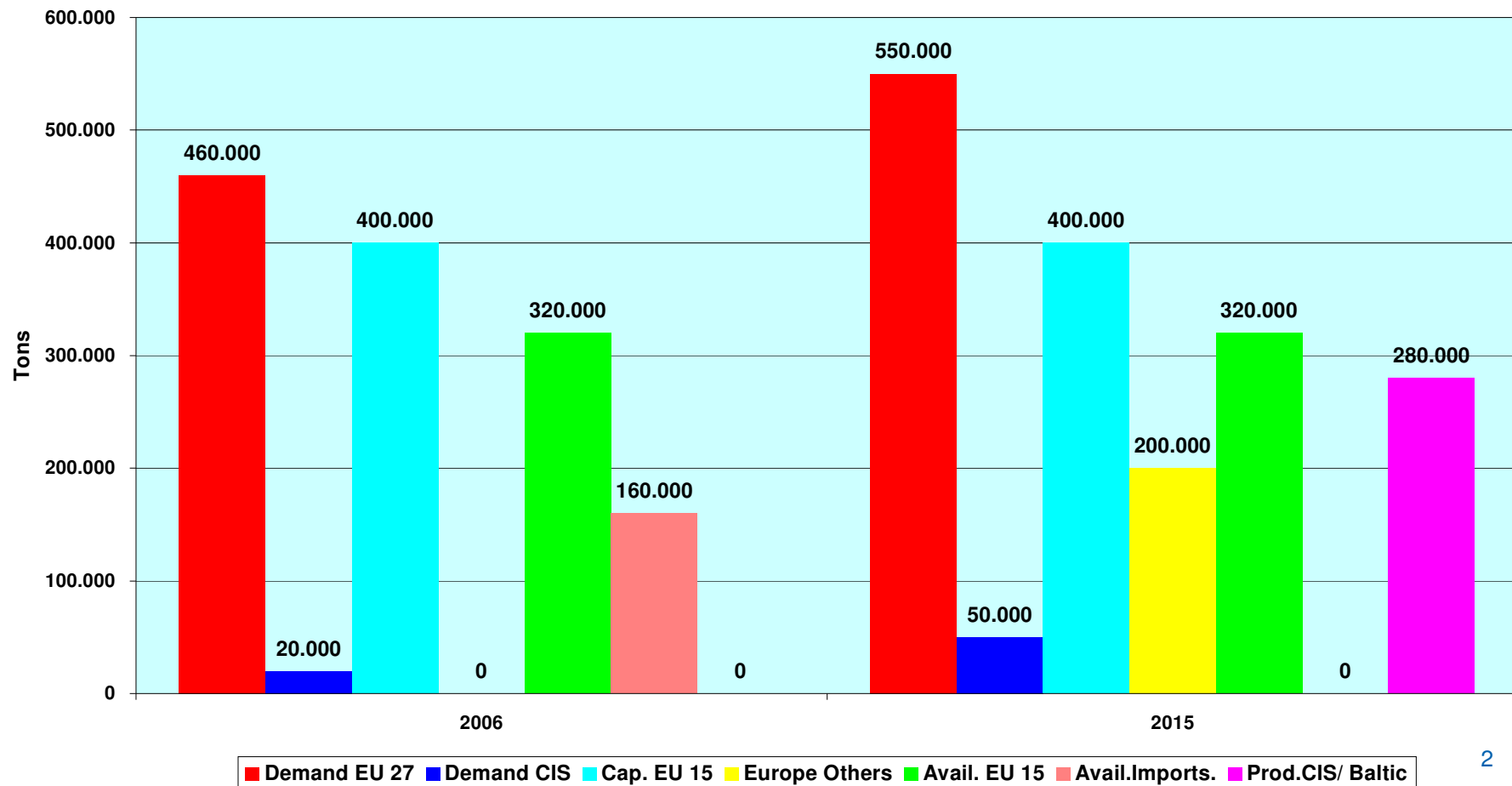
Melamine Conference 5 September 2007

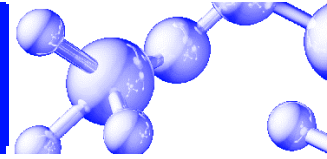
Melamine European Market



Lurgi

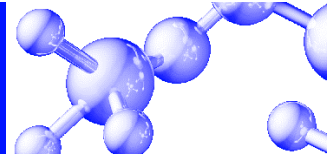
MELAMINE MARKET EUROPE 2006 to 2015



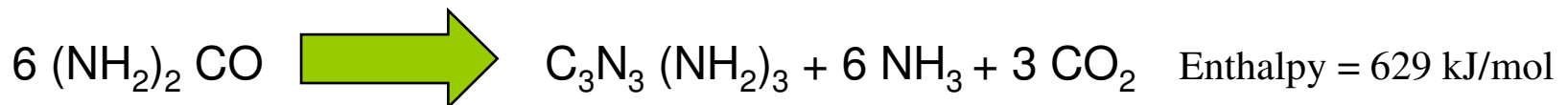
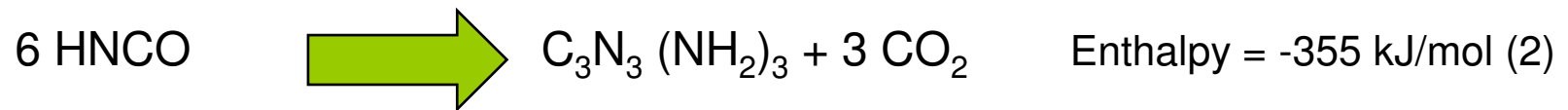
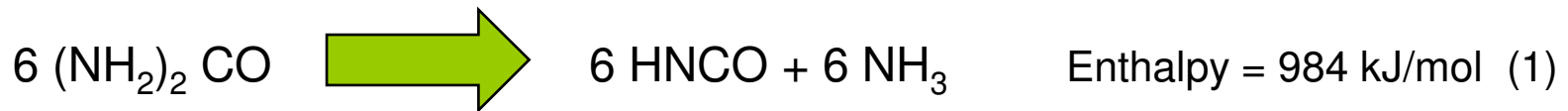
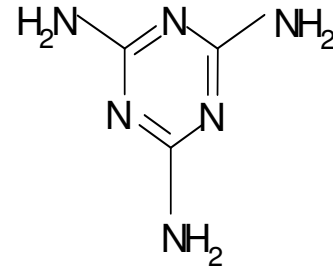


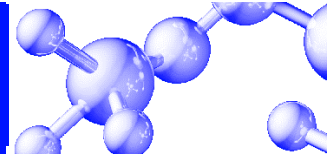
- **Melamine is a white crystalline powder**
- **Quality is defined by:**
 - **Whiteness of product (Apha < 15)**
 - **Purity of product (> 99,8 %)**
 - **Particle size distribution (even, no lumps)**
- **LP material has smaller particles,
HP product is generally rather coarse**
- **LP product is perfect for paints/coatings
and equals HP product in every other
application**

Melamine Chemistry



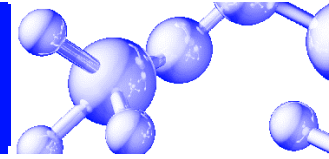
Lurgi





TECHNICAL PREREQUISITS

- **On-Site production of both ammonia and urea**
- **Ammonia plant reasonably efficient**
 - specific natural gas consumption app. 1.200 m³ per ton of ammonia or better
 - CO₂ / Steam balance important
 - Qualified operators and proven maintenance record of plants
- **Capacity and technical condition of urea plant**
 - 3x capacity of melamine needed as urea supply
 - Acceptance of small reduction of urea output or readiness to revamp plant



Low Pressure

- Catalyst mandatory
- Fluidized-bed reactor
- Process conditions:

app. 400 °C

max.10 bar (depends on
process)

- **Low capex** since standard vessels and steel grades can be used
- Higher operating cost due to catalyst use and utility consumption

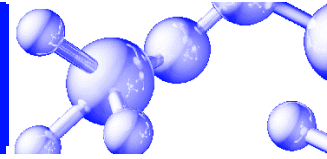
High Pressure

- No catalyst required
- Liquid Phase Reactor
- Process conditions:

app. 400 °C

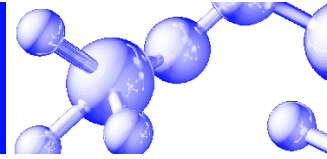
app. 80 to 130 bar

- **High capex** special steel grades; # of supplies limited
- Slightly lower operating cost:
no catalyst, utility consumption⁶
depends on process

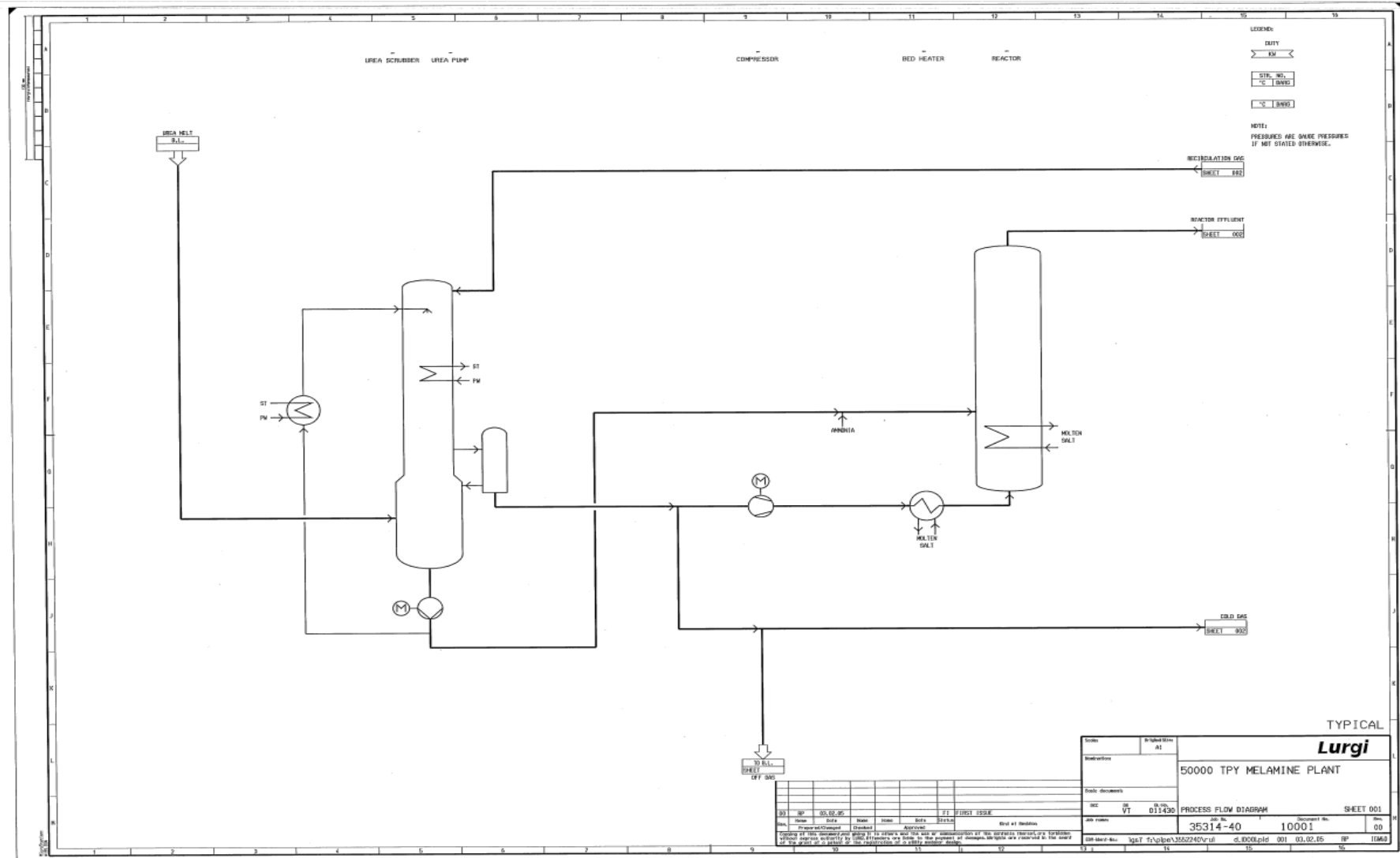


- **Until 2006 only established melamine producers AMI, DSM, BASF and NISSAN owned proprietary technology.**
- **Practically no licensing outside of JV structures to avoid new competition**
- **Italian Eurotecnica offers rather expensive and difficult to operate high-pressure technology**
- **Since 2007 LURGI AG can offer a proven, easy to operate and attractively priced low-pressure production technology**

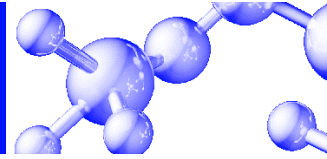
Melamine LP Process (1)



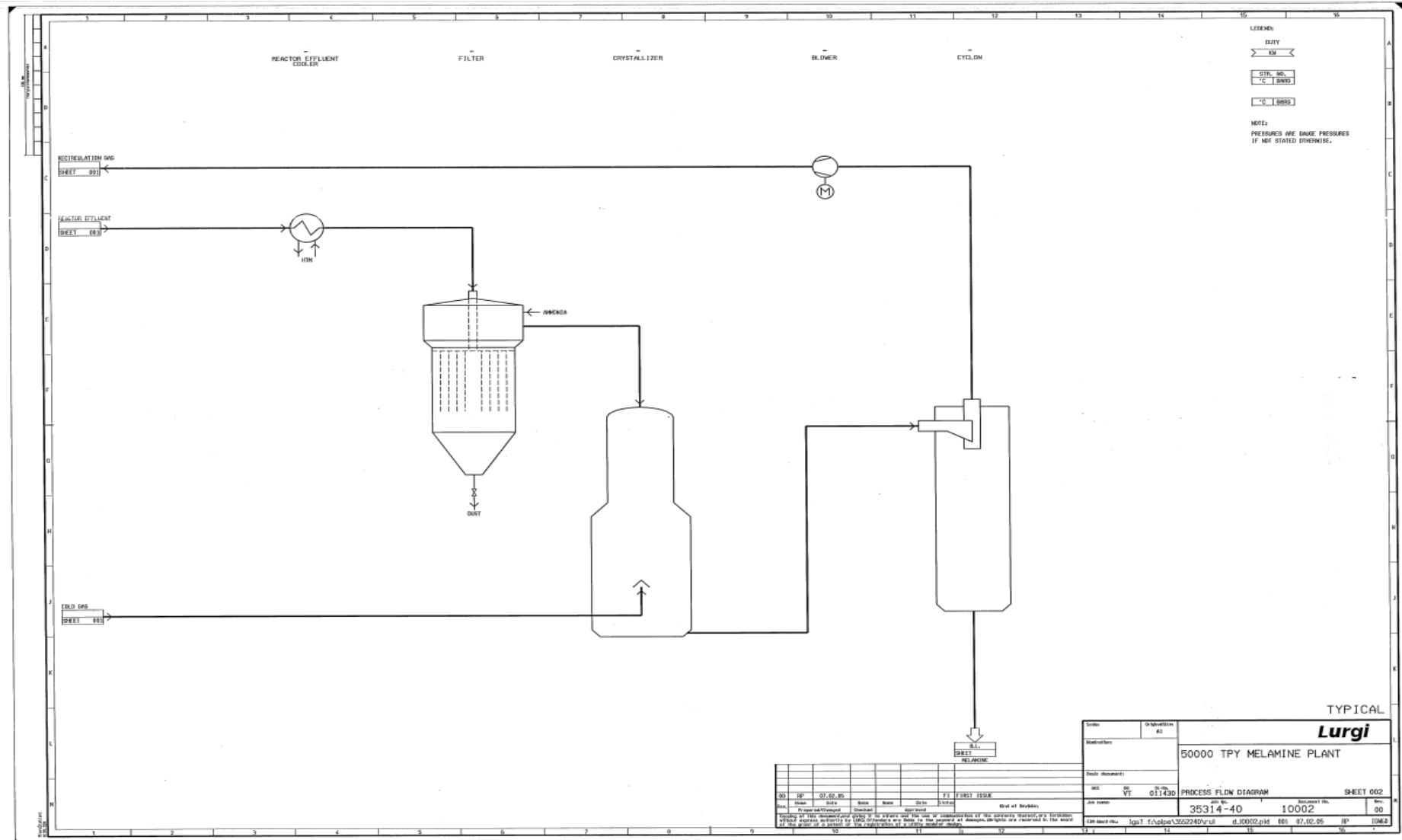
Lurgi



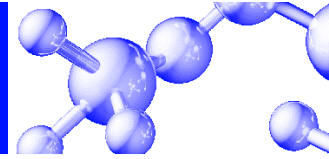
Melamine LP Process (2)



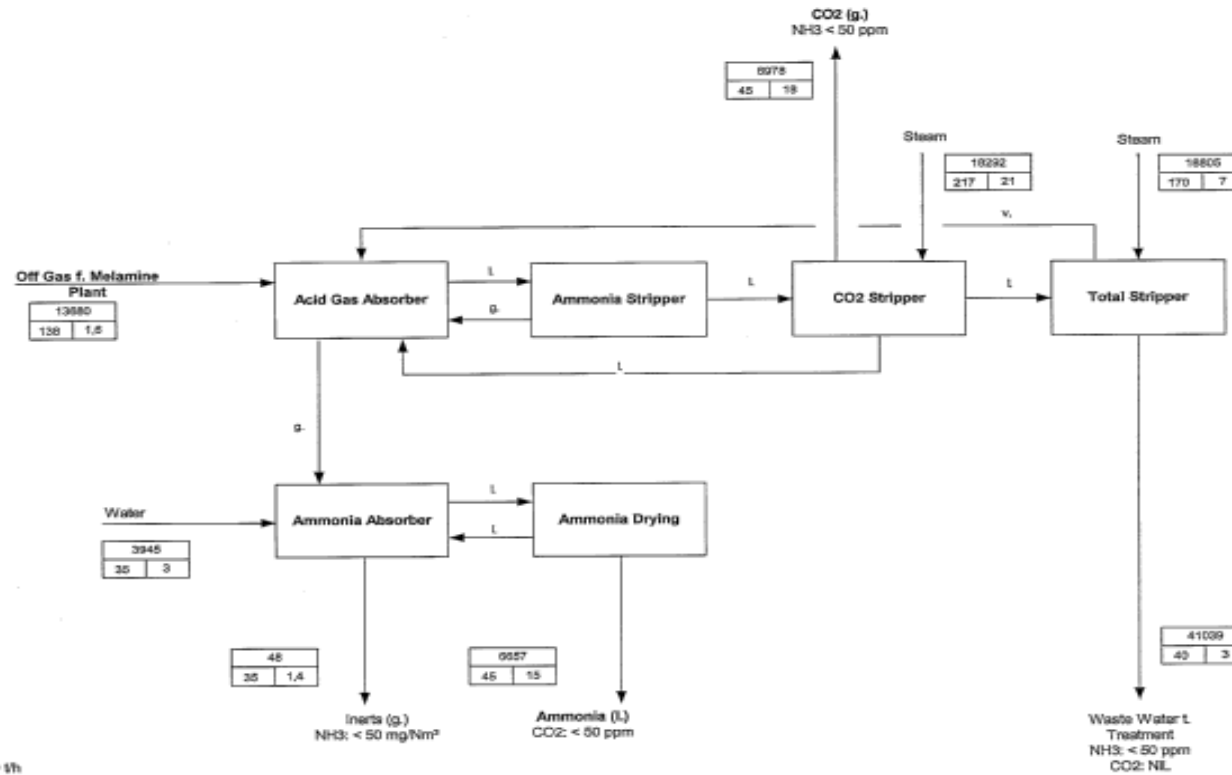
Lurgi



Melamine SACO®



Lurgi



Utility Consumption:

- Power: ~ 500kW
~ 75 kWh/tNH₃
- Steam (7 barg): ~ 19 t/h
~ 2,8 t/t NH₃
- Steam (21 barg): ~ 18 t/h
~ 2,7 t/t NH₃
- CW: ~ 30 MW
~ 4,5 MW/t NH₃
- Demin Water: ~ 4 t/h
~ 0,9 t/t NH₃

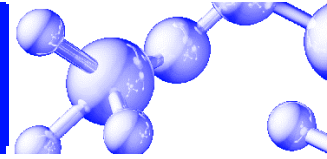
kg/h
°C barg

ID	Name	Date	Name	Date	Status	Kind of Revision

Prepared	Date	Name	Lurgi
Checked	23.03.05	Schitt	
Sheet	50000 MTPY Melamine Plant Unit 20 SACO Unit Block Flow Diagram		
Standard			
Process	Melamine	JAW/DSM	35072-40
		Name	PUSR

20030222_Block Flow diagram (preliminary) Unit 20 SACO Unit (preliminary)

Melamine LP - Consumption Figures

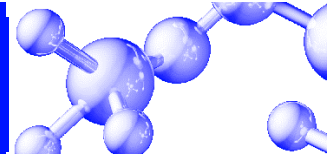


Lurgi

Item	Unit	Figures
Urea	t / t Melamine	3,1*
Ammonia	t / t Melamine	0,2
Catalyst	kg / t Melamine	3
Power	kWh / t Melamine	700
Steam 13 bar	t / t Melamine	0,8
Cooling Water	m ³ / t Melamine	20
Fuel Gas	GJ / t Melamine	12

* Net Value: 1,5 t Urea / t Melamine

Melamine Feasibility

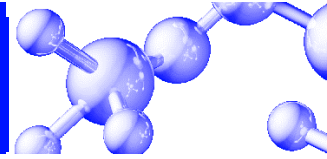


Lurgi

Investment: 100 Million €

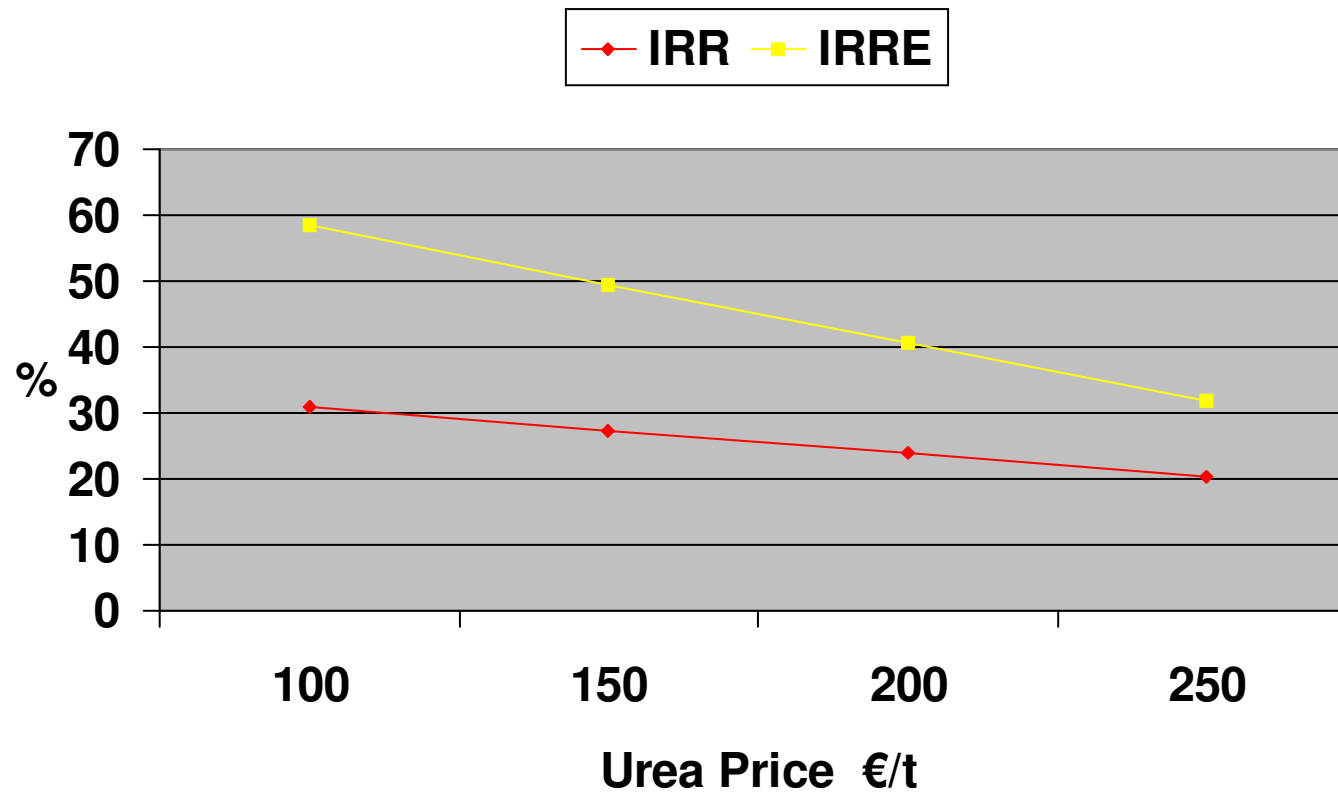
Interest Rate	8 %
Interest during construction	capitalized
Repayment	10 years
Tax	0 %
Equity	30 %
Construction Period	2 years

Melamine Feasibility

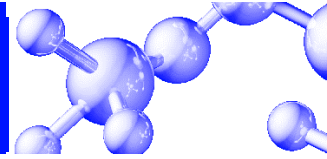


Lurgi

Melamine: 1000 €/t

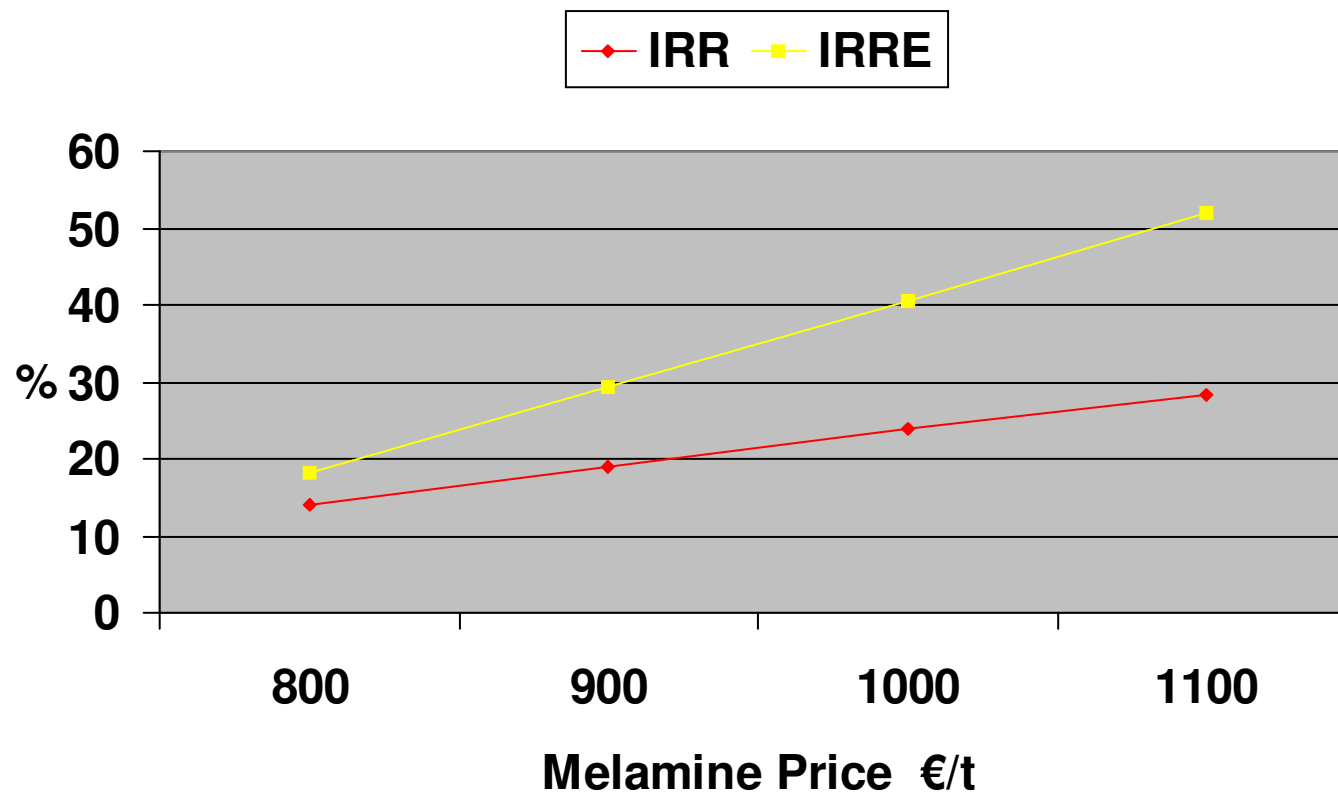


Melamine Feasibility



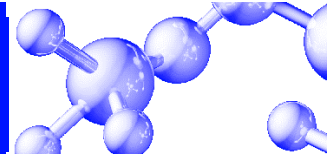
Lurgi

Urea: 200 €/t



Melamine

The Value Added



Lurgi

- **Natural gas cost of USD 50/ Tm³ lead to urea production costs of app. USD 70/ mt.**
- **At USD 250/ mt urea the net profit achieved is appr. USD 180 or € 135/ mt.**
- **Melamine prices on average are expected at 950 – 1000 €/mt. Production costs incl. all feedstock are estimated at € 450/ mt**
- **Melamine plant will generate a profit of € 500/ mt, that's € 365/ mt above urea profit.**
- **Based on 50 kt melamine capacity that's € 18,25 million per year of additional profit**