



Experiences and potentials in replacing rigid foam manufacturing equipment in Article 5 countries

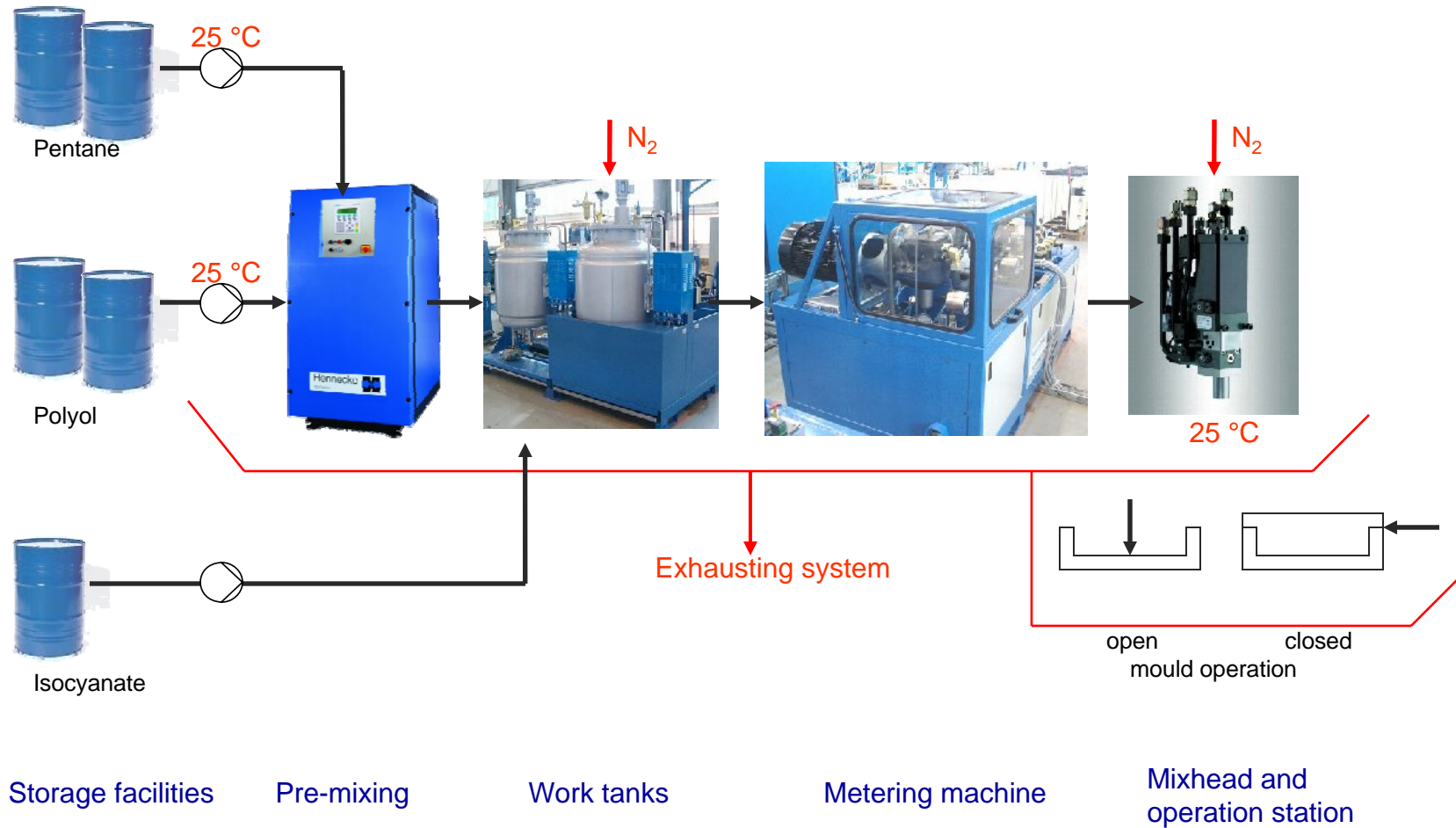
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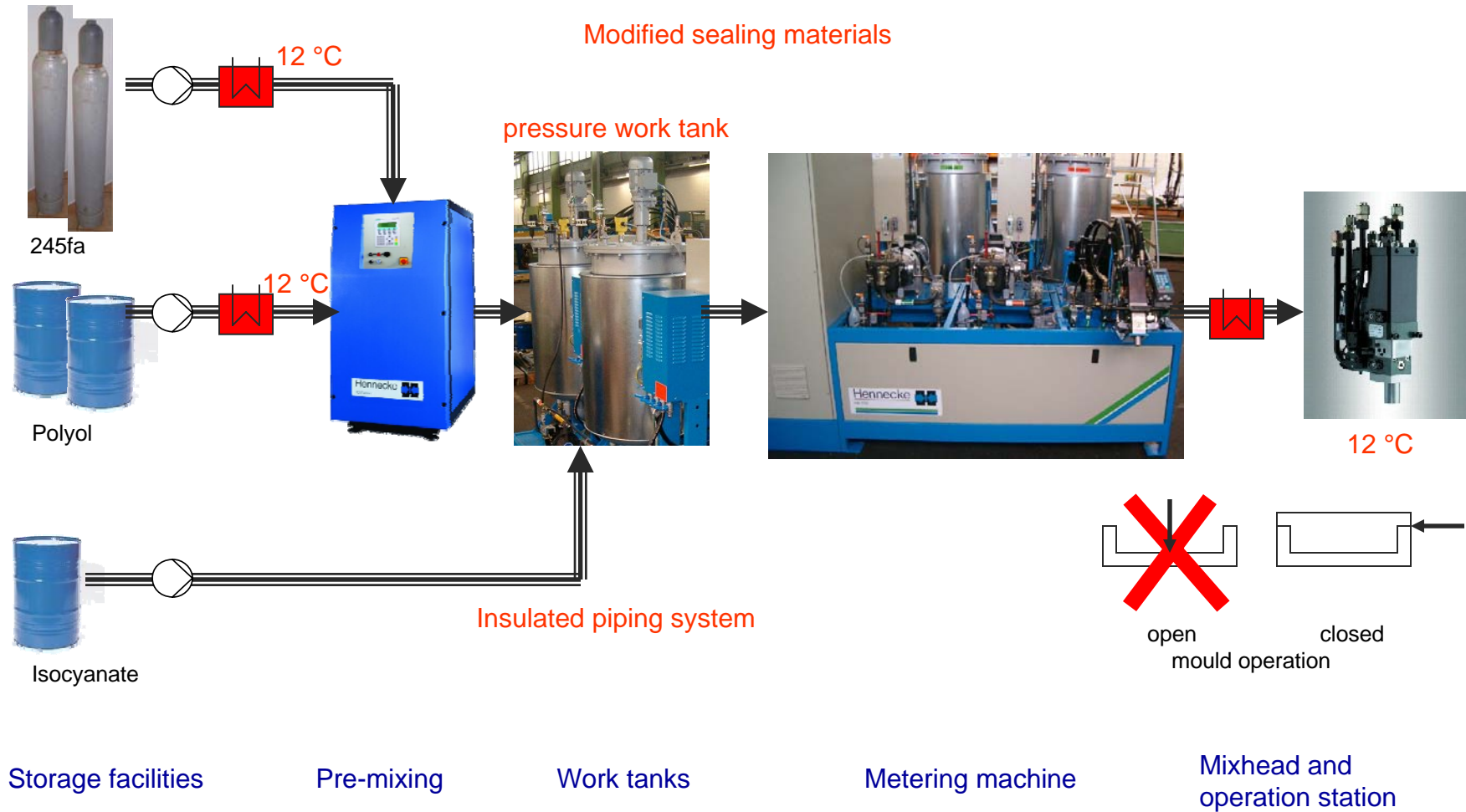
Montreal, 06.04.2008



Process requirement Pentane driven PUR-systems



Process requirement 245fa driven PUR-systems

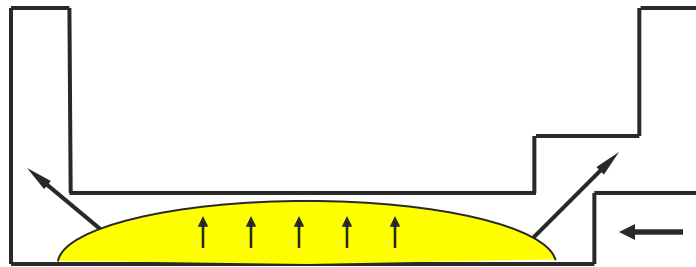




Foam distribution Pentane and 245fa driven PUR-system Cabinet production process

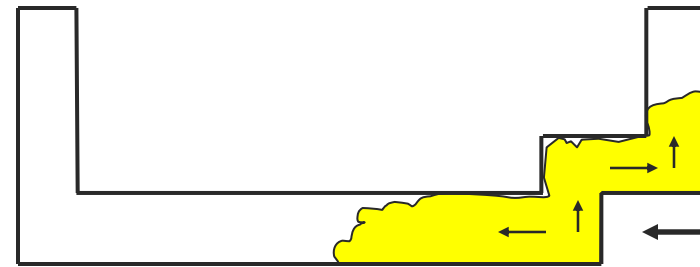


Fluid pouring process



Pentane driven PUR-system
standard conditions

Frothed pouring process



245fa driven PUR-system
without optimized temperature control

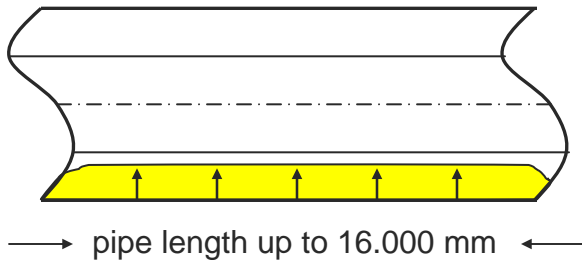


Foam distribution Pentane and 245fa driven PUR-system

Pipe insulation process

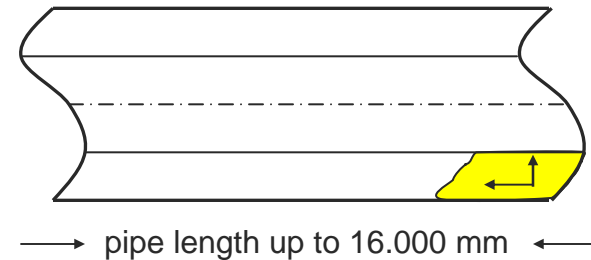


Fluid pouring process



Pentane driven PUR-system
standard conditions

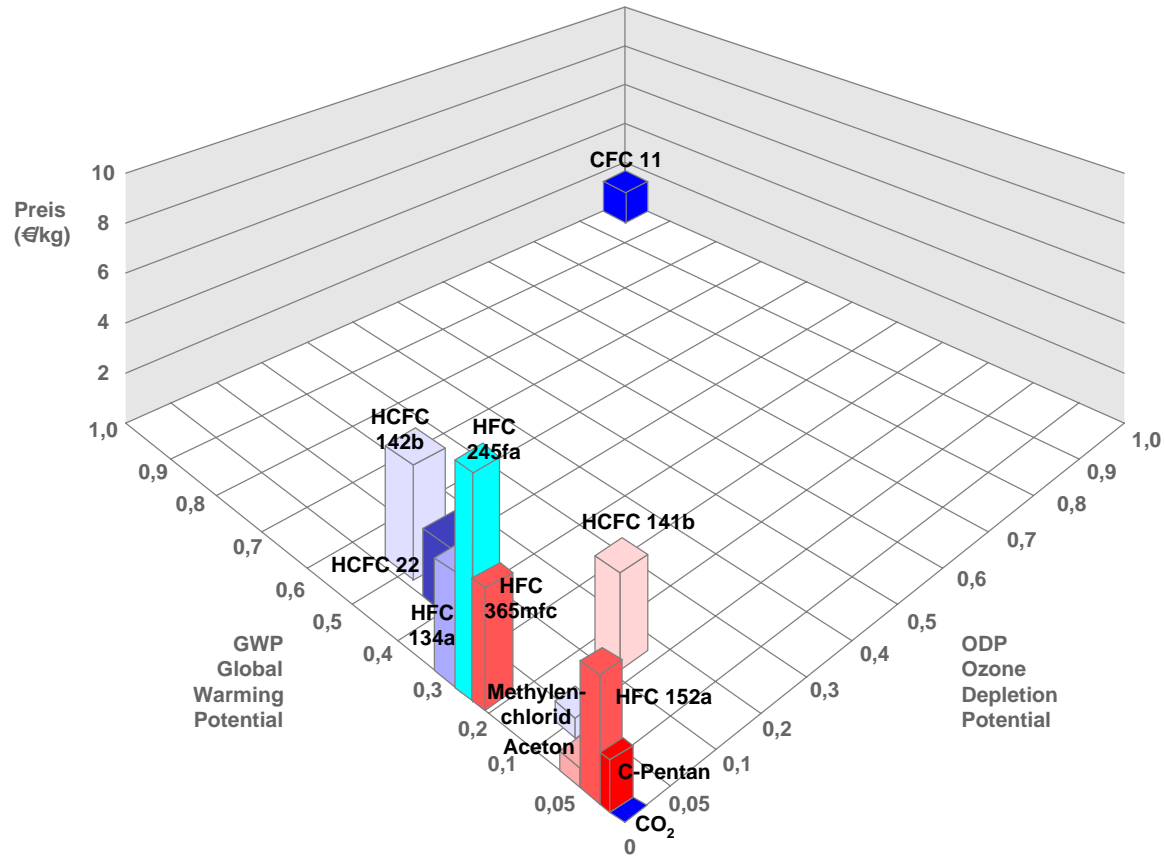
Frothed pouring process



245fa driven PUR-system
without optimized temperature control



Current physical blowing agents



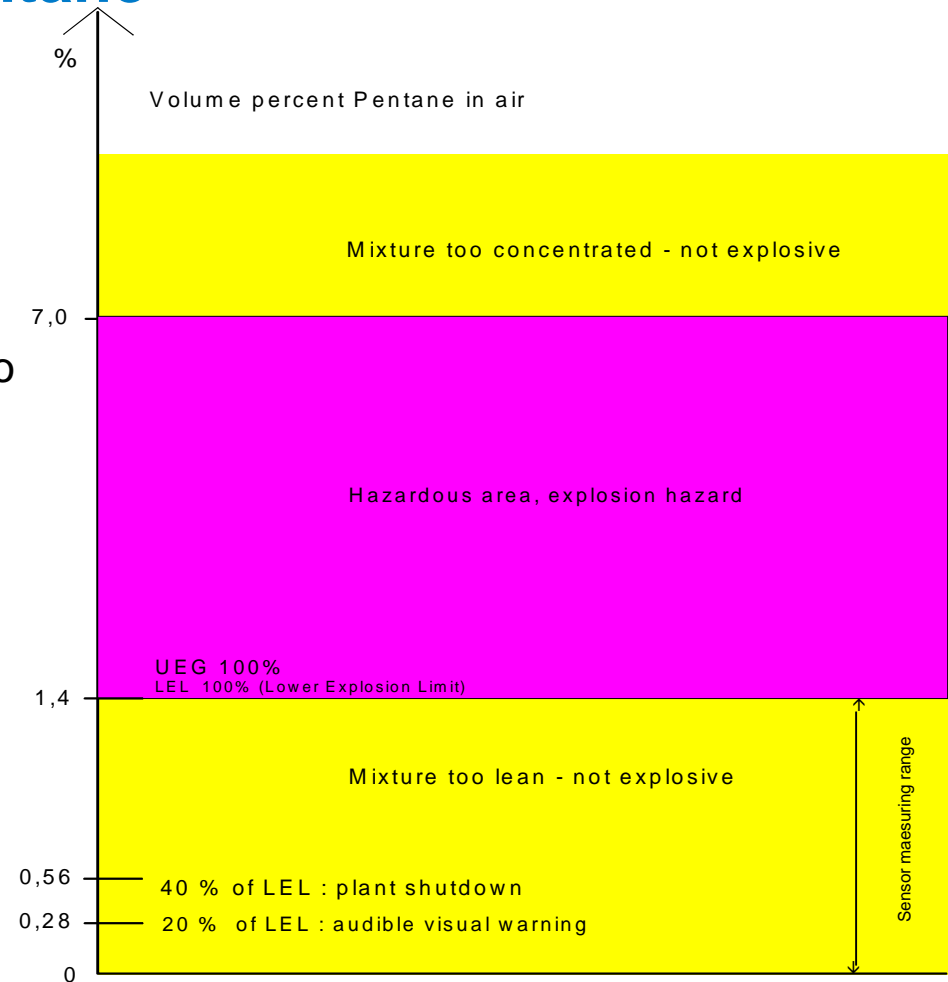


Important when using pentane

- Pentane will form, together with air, an explosive mixture (Between 1,7 to 7 Vol-% pentane in the air)
- Poly- Pentane mixture is a liquid categorized as an A1 hazard (similar to petrol)
- Safety measures have to be taken when processing pentane

Basic principle :

Avoiding the formation of a flammable, explosive mixture of pentane and air





Primary Explosion Proofing is achieved by

- monitored air changing
- gas warning system
- neutralization of daytanks and moulds with inert nitrogen
- equipotential bonding (earthing)

Primary Explosion Proofing is essential!

Secondary Explosion Proofing is achieved by

- Avoidance of ignition sources
- Use of explosion proofed parts with certification according to ATEX



Design of a pentane metering plant

A plant for processing pentane as a blowing agent for PUR-systems consists of the following components :

- Pentane storage
- Polyol storage
- Premixing unit for the mixing of polyol and pentane
- Metering unit for the high-pressure metering and mixing of the polyol-pentane blend and isocyanate (assuming LP machines will not be used for pentane)
- Working and foaming area



Pentane supplies via hazardous Goods Container

- Interchangeable vessels (100 - 1000 l)
- Refilling from standard 200l Pentane drums
- Expansion tank with level control
- Storage outside of the plant
- **System approved by German TÜV and used since more than 10 years**





Premixing station for metering pentane into polyol

- Enclosure incl. doors, leakage pan and ventilation duct
- Metering units, consisting of high pressure pumps for polyol and pentane
- Static mixer





Realized Projects: Technical aspects defining costs

- Part information
- PU-System data
- Information of the plant location
- Information dry and wet side
- Information foaming stations
- Raw material supply
- Requirements human resources, civil work
- Minimum scope of supply machine manufactures



Example: New Line for District Heating Pipes in Latvia, 2005

KraussMaffei's delivery: 260.000 €

- Pentane Tapping System
- Premixing Unit 40 l/min
- Metering Machine 300 kg/min
- Safety Equipment incl.
Nitrogen Inerting
- Installation/Commissioning/
Training



Customers delivery:

- Exhaust System: 20.000 €
- Grounding: 3.000 €
- Civil Construction: 0 €

No Housing of plant necessary



Example: Retrofit of Line for District Heating Pipes in Romania, 2007

KraussMaffei's delivery: 150.000 €

- Pentane Tapping System
- Premixing Unit 40 l/min
- Retrofit of Metering Machine 150 kg/min, consisting of:
 - Stirrer for day tank with Magnetic Coupling
 - Magnetic Coupling for Metering Pump
 - Ex-Proof pressure switches
- Safety Equipment incl. Nitrogen Inertisation
- Installation/Commissioning/Training

Customers delivery:

- Exhaust System: 10.000 €
- Grounding: 5.000 €
- Civil Construction: 5.000 €

No Housing of plant necessary



Example: New Foaming Line for Production of Refrigerator Cabinets and Doors in Vietnam, 2007

KraussMaffei's delivery: 650.000 €

- Pentane Tapping System
- Premixing Unit 40 l/min incl. 2 x 1.000 ltr. Buffer tanks
- 2 Metering Machines 40 kg/min for foaming of cabinets
- 1 Metering Machine 30 kg/min for foaming of doors
- Safety Equipment incl. Nitrogen Inertisation
- Exhaust System (excluding ducts)
- Installation/Commissioning/Training

Customers delivery:

- Exhaust System: 30.000 €
- Grounding: 8.000 €
- Civil Construction: 0 € Installation in existing building



Example: Retrofit of Refrigerator Line in Chile, 2007

KraussMaffei's delivery: 320.000 €

- Pentane Underground Storage System
- Premixing Unit 40 l/min
- Retrofit of Metering Machine 80 kg/min with 6 Mixing Heads
- Safety Equipment incl. Nitrogen Inertisation
- Installation/Commissioning/Training
- Exhaust System

Customers delivery:

- Civil Construction: 20.000 €



**In Total more than 100 Pentane
References of KraussMaffei all
over the world**



Example: New line for the production of household doors, Iran, dd. 2005

Hennecke's delivery: 260.000 €

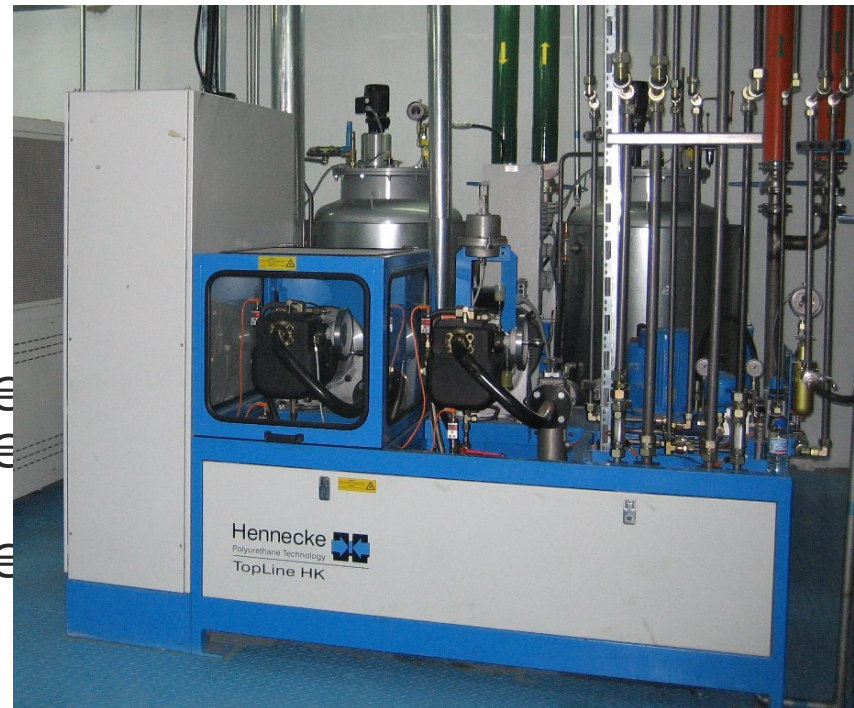
- Pentane storage system (400 l)
- Premixing unit Pentamat 30
- Metering machine 1300 g/s
- Pentane safety system
- Exhausting fans

Customers delivery:

- Exhausting ducts: 15.000 €
- Piping works: 3.000 €
- Grounding, interface to PPT-safety system: 5.000 €
- Nitrogen (gas cylinder)

No Housing of plant necessary

No Electricity Backup necessary





Example: New line for pipe fittings (insulation), Germany, dd. 2006

Hennecke's delivery: 230.000 €

- Premixing unit Pentamat 30
- Metering machine 1300 g/s
- Safety system incl. Pentane sensors and monitoring
- Exhausting fans
- Inertisation system

Customers delivery:

- Storage (container): 20.000 €
- Grounding, interface to PPT-safety system: 15.000 €
- Exhausting ducts: 12.000 €
- Nitrogen generator: 22.000 €

No Housing of plant necessary

No Electricity Backup necessary





Example: Pentane conversion of a production line for pipe insulation, Ukraine, dd. 2007

Hennecke's delivery: 400.000 €

- Retrofitting of 2 metering machines, each 300 kg/h, with totally 8 foaming stations
- Premixing unit Pentamat 30
- Pentane safety system incl. Pentane sensors and monitoring
- Pentane supply by drums

Customers delivery:

- Exhausting system: 15.000 €
- Grounding, interface to PPT-safety system: 15.000 €
- Nitrogen generator: 22.000 €

No Housing of plant necessary

No Electricity Backup necessary





**In Total more than 250 Pentane
References of Hennecke all over
the world**



Resumee

- 245fa harmful to the climate (according to Swiss “Federal Office for the Environment FOEN” 800 - 1000 more harmful than CO₂)
- 245fa already forbidden in countries like Sweden
- Combustion of 245fa creates toxicological substances
- Handling of 245fa not as easy as oftenly assumed
- λ-value of 245fa almost similar with Pentane
- 245fa much more expensive
- Out of NAFTA region 245fa only used at customers with very small consumption
- Simple Pentane Storage Equipment available and proven
- Oftenly (depending on the design of the exhausting system) no housing necessary
- Pentane technology accepted and implemented worldwide since 1993
- Retrofit of Low Pressure machines to Pentane not efficient
- Costs for retrofit of High Pressure machines depending on local situation



Thank you for listening.