POLYURETHANE TECHNOLOGY

Substitution of HCFC in foaming equipment: state of the art and new technologies

www.afros.it

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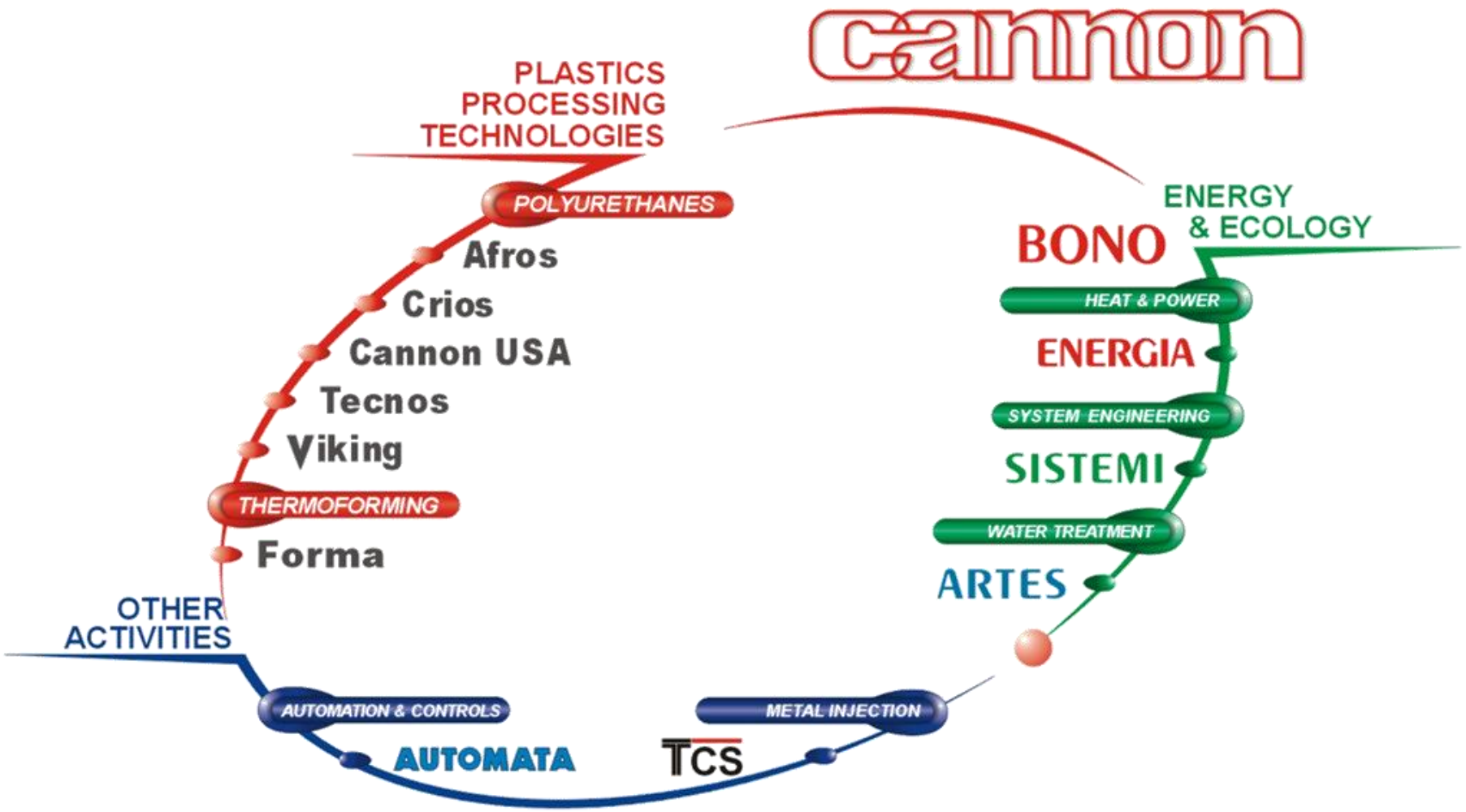
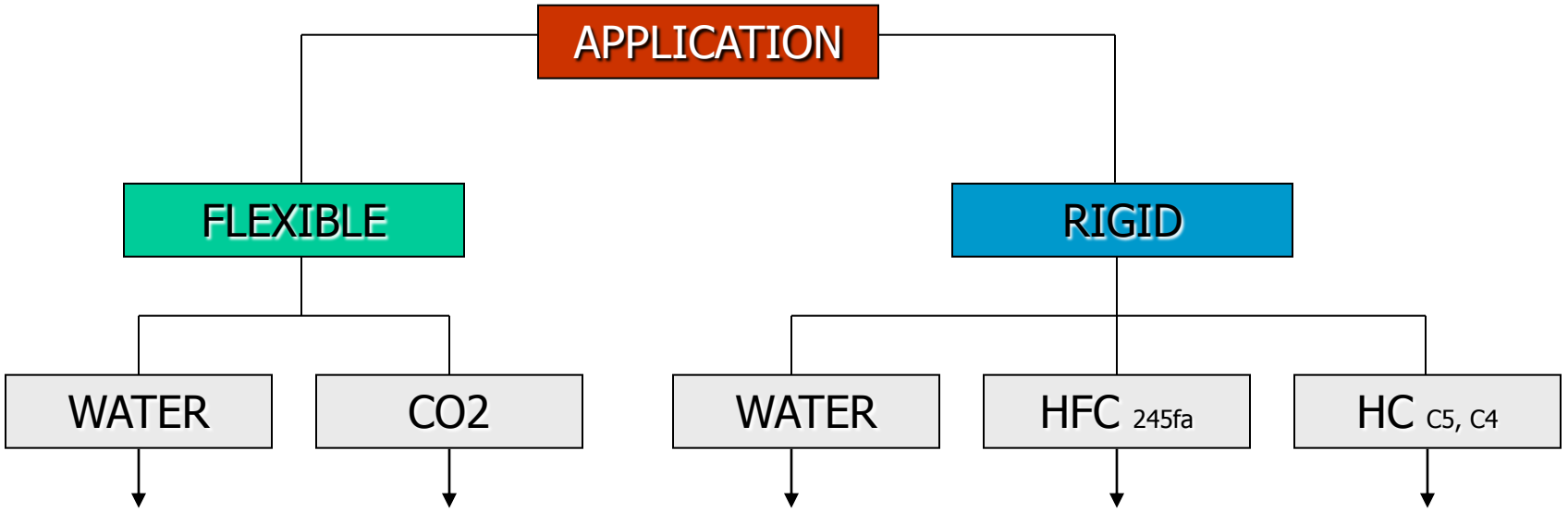
Cannon Group: Structure & Synergies



Substitution of HCFC in Foaming Equipment: The Scheme



1) Main Technical Issues

2) Possible Innovations

HCFC Substitution for Rigid Foams

Industrially available solutions:

HCFC (141b)

- H_2O → Chemical CO_2
- HFC → Mainly 245fa
- HC → Pentane, Isobutane, …

Chemical CO_2: ICC

- **Low Pressure**

General machine check-up and refurbishing

- **High Pressure**

General machine check-up and refurbishing:

BUT … lower performances in terms of insulation properties!

HFC (245fa)

Main factors are:

- **Chemical temperature controls**

  - heat exchangers along the pipelines
  - higher cooling power for dosing units

- **Frothing Effects**

  - from open mould to closed mould technology

HC (C_5H_{10}, C_4H_8, ...)

Main factors are:

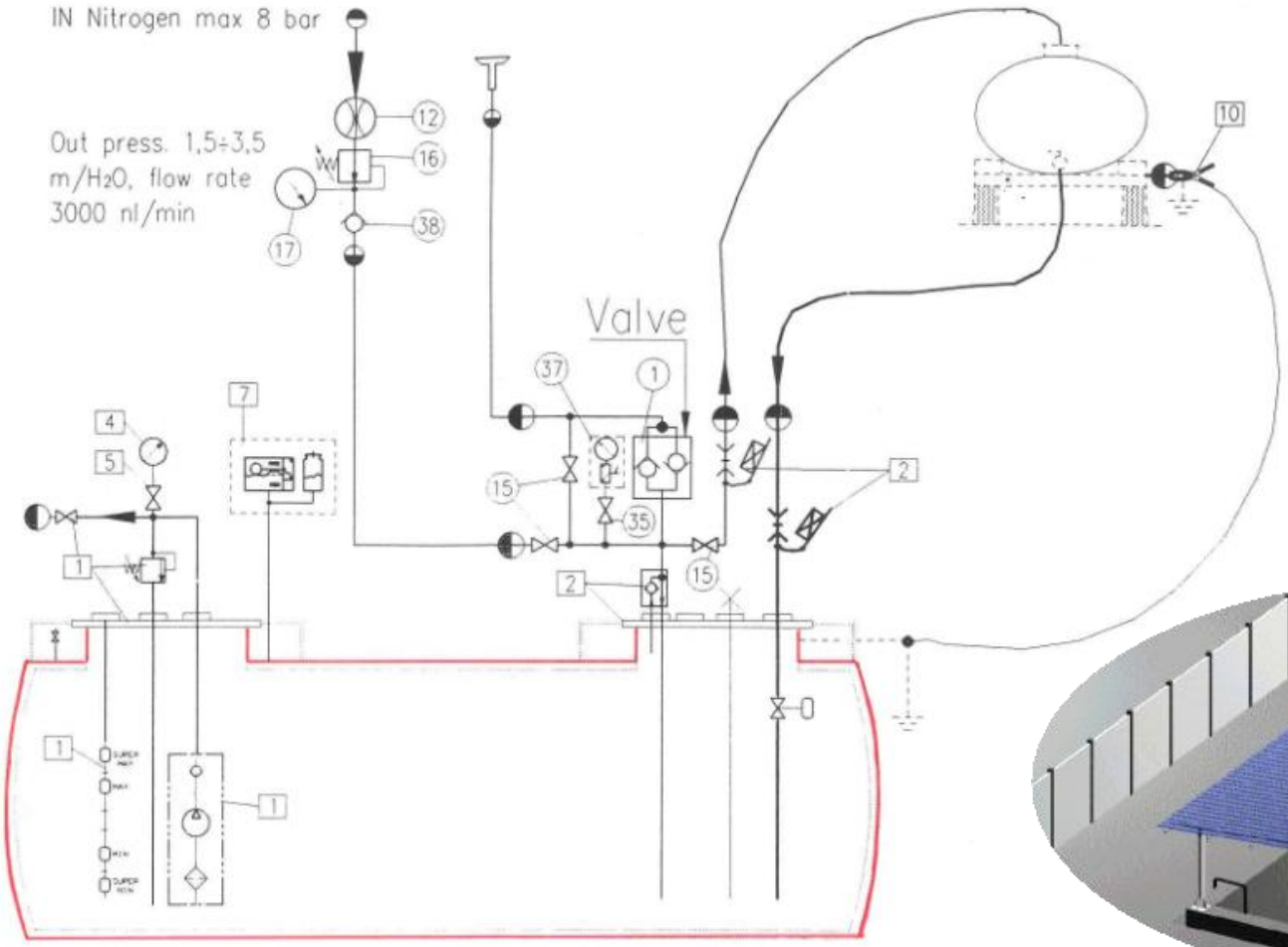
- **Hardware**

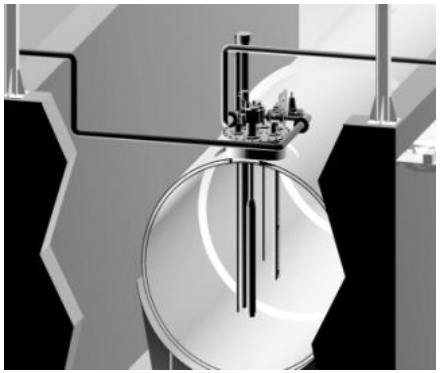
  - dosing units update
  - new premix units
  - BA storage systems

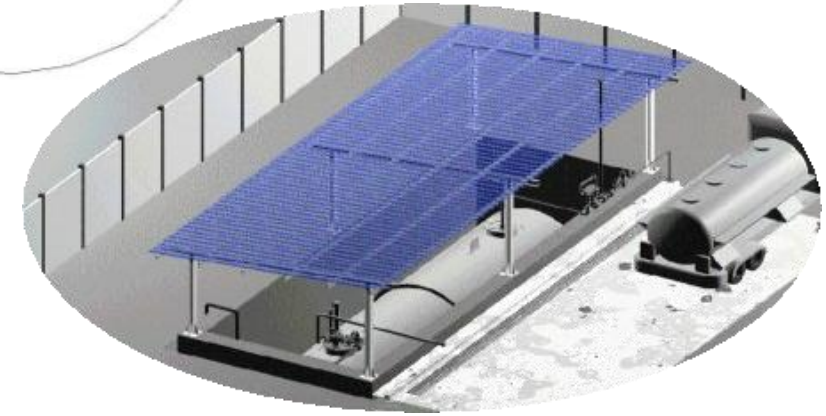
- **Software**

  - safety

Storage System: Underground Tank







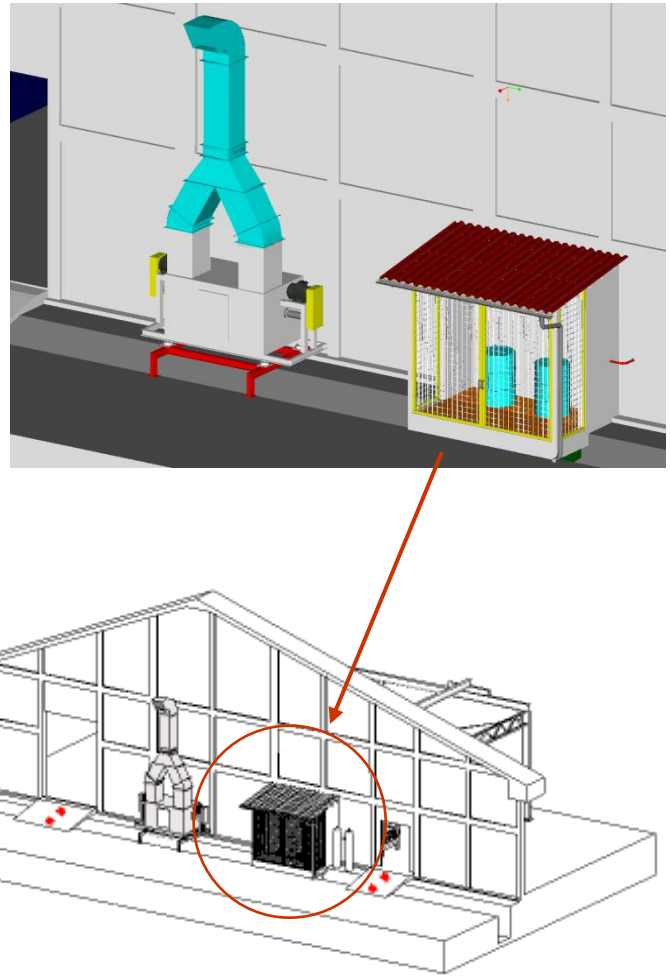
Storage System: by Drums

Particularly suitable for pilot plants and small production lines.

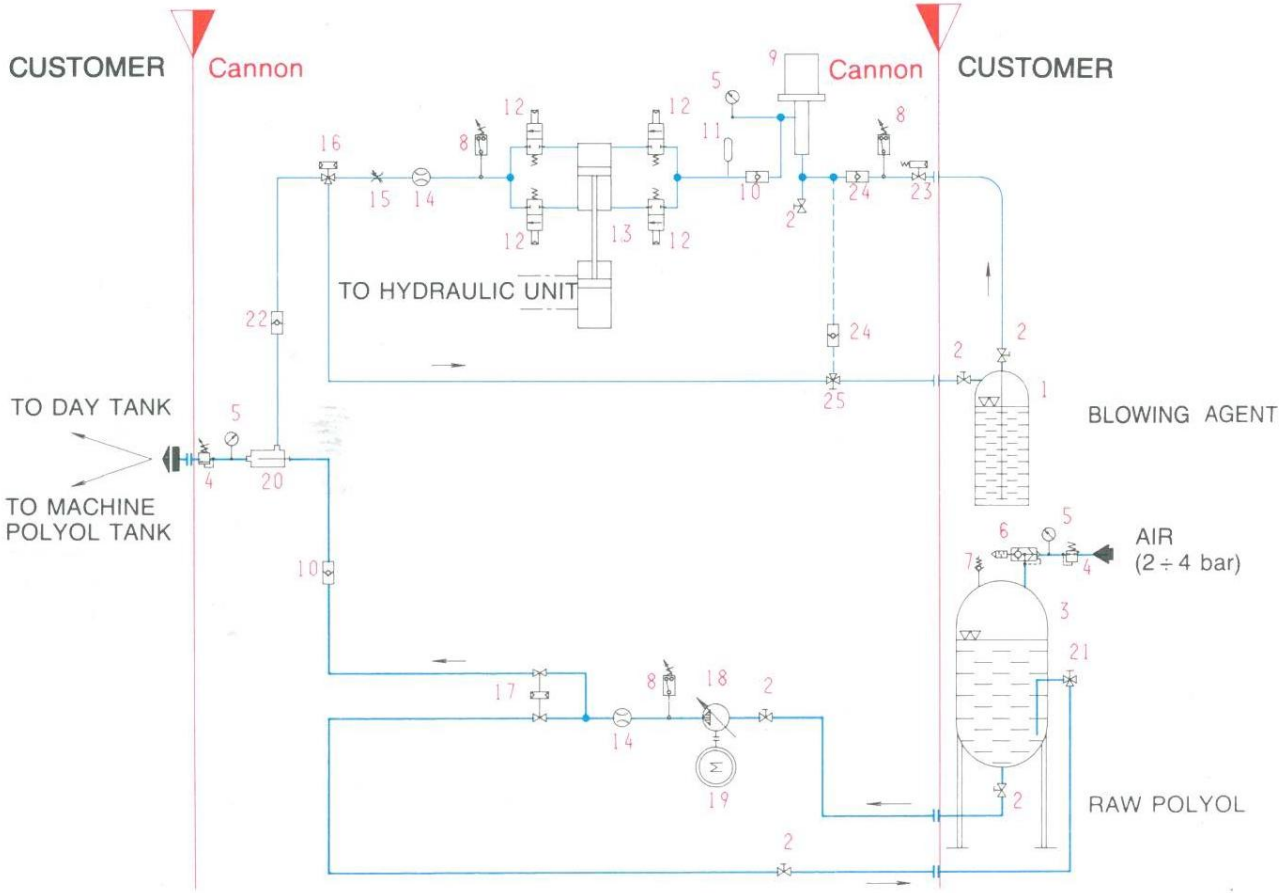
Particular cares:

- the drums must be provided with Nitrogen blanketing system (class B drum): this means that there must be 2 plugs, one for the pneumatic pump and the other one for the Nitrogen line

- the storage must be placed under a roof and in naturally ventilated area



Premix Units



1 Blowing Agent tank
2 Ball valve
3 Raw Polyol tank
4 Pressure regulator valve
5 Pressure gauge
6 Fast discharge valve
7 Safety valve
8 Pressure switch
9 Pneumatic booster
10 Non-return valve
11 Accumulator
12 On-Off valve
13 Double acting piston pump
14 Flow transducer
15 Manual counter-pressure valve
16 3-way valve
17 Double stream distributor
18 Pistons pump
19 Motor
20 Static mixer
21 Manual three-way valve
22 Non-return valve
*23 Shut-off valve ''fire-safe''
*24 Non-return valve
*25 Manual three-way valve

* **Multi EasyFroth™** only

Premix Units

General View

Polyol Pump

Static Mixer inside

Ventilated Box

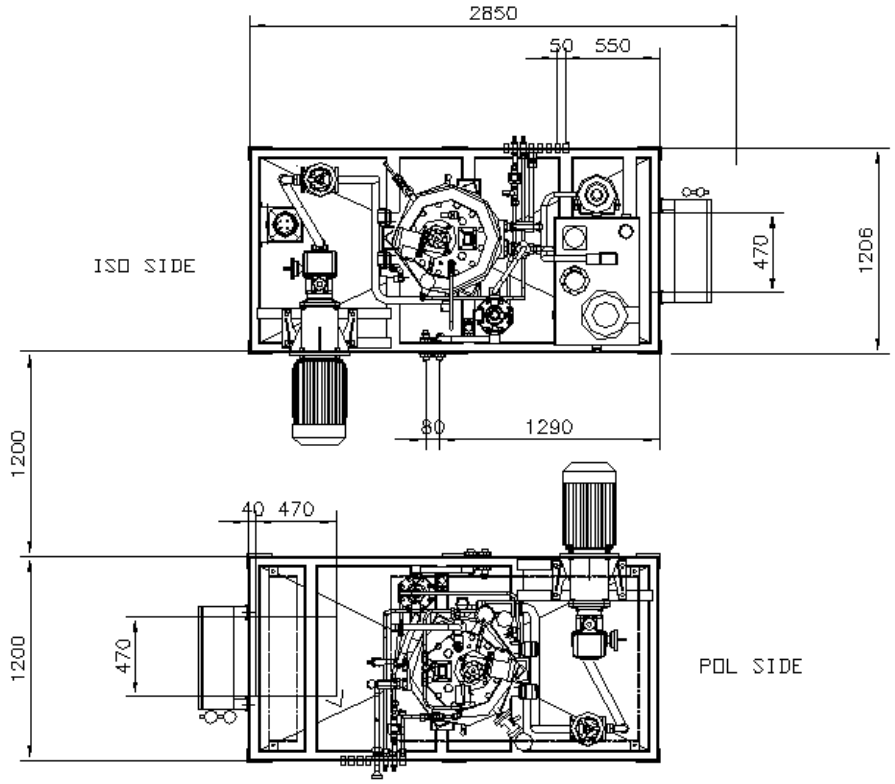
Dosing Units Update

1) **Low Pressure** → replacement with High Pressure

2) **High Pressure** → adding new Polyol side only by keeping the existing Isocyanate

3) **Mixing Heads** → evaluation of possible replacement with N_2 injection system

Dosing Units Update



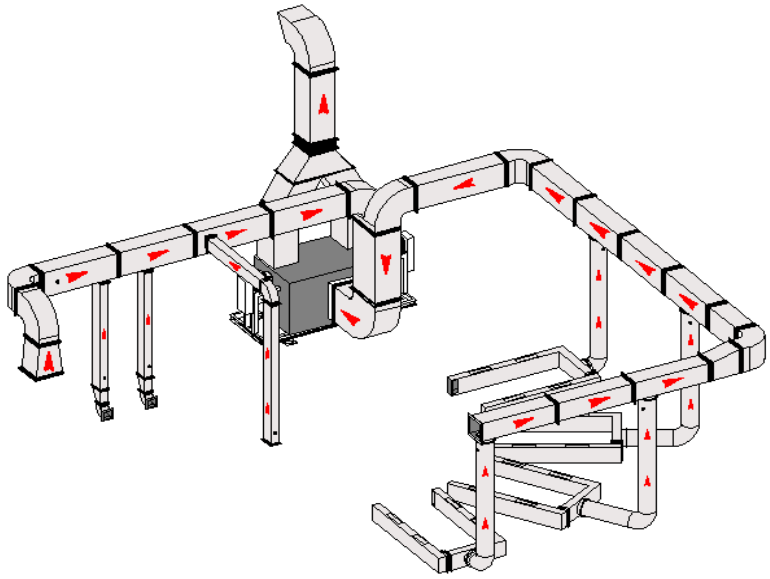
Safety

- classification and limitation of hazardous area
- ventilation system
- gas sensors (catalytic/infrared)
- safety control cabinet
- white book
- safety report
- TUV certification (eventually)

Ventilation System

- **Wet End**

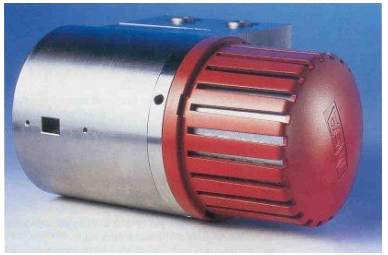
  - double version
  - first fan always ON
  - second fan in case of emergency



- **Dry End**

  - single version
  - ON in case of production only

Gas Sensors



- Ex-d rated
- back-up system
- always in operation
- alarms:
    - 15% of LEL ventilation increase
    - 30% of LEL ventilation increase and power cut-off

Safety Control Cabinet

- electro-mechanical
- PLC based
- alarms, signals and controls:
    - low
    - medium
    - high

White Book and Safety Report

- project for the modification of the existing plant

- safety criteria and relevant conclusions of the specific project

- very useful (or even mandatory) for local authorisation approval

ecomate

Presented at the
12th Annual Green Chemistry
& Engineering Conference
26June08
By Foam Supplies Incorporated

Use of MeF in PU process

Adding MeF creates a mildly acidic environment when processed in PU applications

Use of MeF in PU process: initial experiences: a case history

Customer (making commercial refrigerator) who started to use Pol-MeF blends with their standard machine experienced the following evident hardware effects:

- metering efficiency lost
- unusual wear of nozzles with relevant mixing problem

… within a short time from the formulation change

Use of MeF in PU process: initial experiences: a case history

We have arranged technical intervention to make inspection and ck of the situation:

- pump group has been dismantled
- evident abrasion/corrosion effects have been noticed on
  - bearings → <u>they have been replaced</u>
  - pump axial piston, even if less critical
- the polyol nozzle shown an anomalous wear → <u>they have been replaced</u>

Use of MeF in PU process: initial experiences: a case history

Use of MeF in PU process: initial experiences: a case history

Use of MeF in PU process: initial experiences: a case history

With a production rate of 40-50 shots/hour, the required maintenance to keep the machine in efficient production conditions was:

- change of polyol nozzle every 1 month
- change of bearings group every 2 months
- change of pump every third bearings change

Use of MeF in PU process: initial experiences: a case history

- Customer noticed that with higher production rates, maintenance intervals were longer

- After 4 months, the flow transducer too start showing evident abrasion/corrosion conditions

Use of MeF in PU process: initial experiences: a case history

Our conclusions have been:

1. The more the material stagnates, the more evident is the acid attack
2. Definition of a dedicated 'kit' to apply to a standard machine to make it suitable to process MeF formulation with acceptable (almost normal) maintenance tasks/costs

Use of MeF in PU process: initial experiences: a case history

- Modification of the pump circuit to flush bearings
- Mixing spool and injector nozzles specifically treated (Cannon has developped a dedicated surface treatment)
- Dosing pump specifically treated (Cannon has developped a dedicated surface treatment)
- Stainless steel flow transducer
- Epoxy resin coating of the tank (if possible)

With this simple modifications, a standard machine suitable to work with acid formulations

Honeywell HFO-1234ze Blowing Agent

trans – 1,3,3,3-tetrafluoropropene

Product information

Trade name : HFO-1234ze, HBA-1

Use of the sustance/preparation :

Aerosol propellant

Foam blowing agent

Refrigerant

Company/Undertaking Identification

Company : Honeywell Fluorine Products Europe B.V.

Innovations related to HCFC Substitution

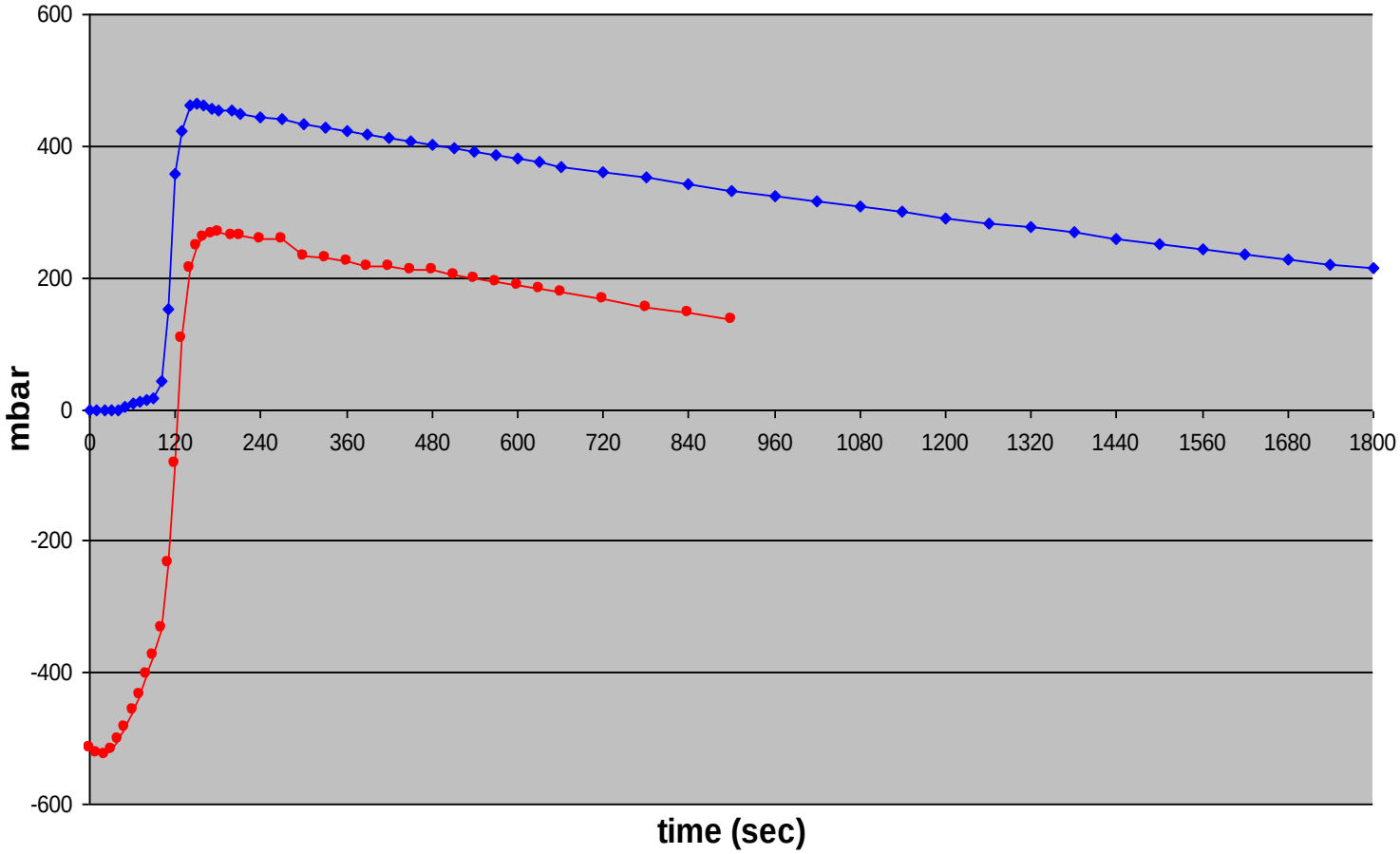
- vacuum assisted injection (VAI) *

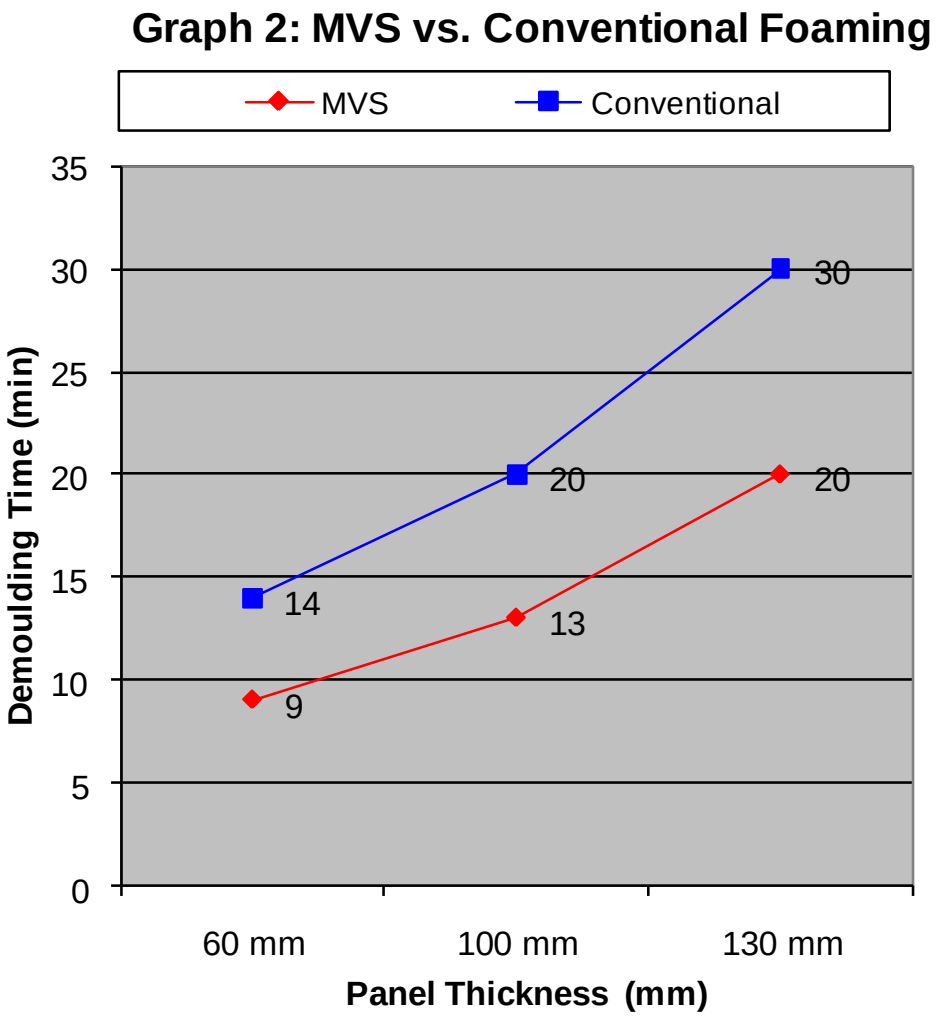
- JL mixing head (Cannon Patent) **

* for rigid foam applications, closed mould technology, any BA

** especially for LBBA (CO2, 245fa, isobutane) based formulations

Graph 1: Pressure in the Mould




Graph 2: MVS vs. Conventional Foaming
MVS
Conventional
Demoulding Time (min)
35
30
25
20
15
10
5
0
30
20
20
14
13
9
60 mm
100 mm
130 mm
Panel Thickness (mm)

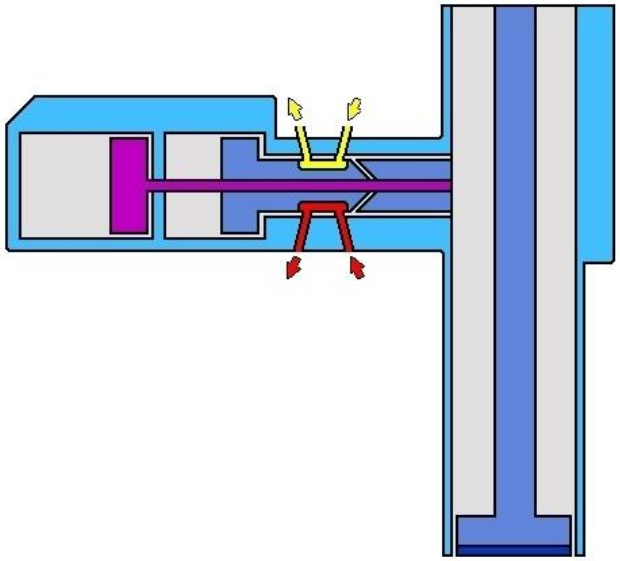
Cannon JL High Pressure Mixing Head

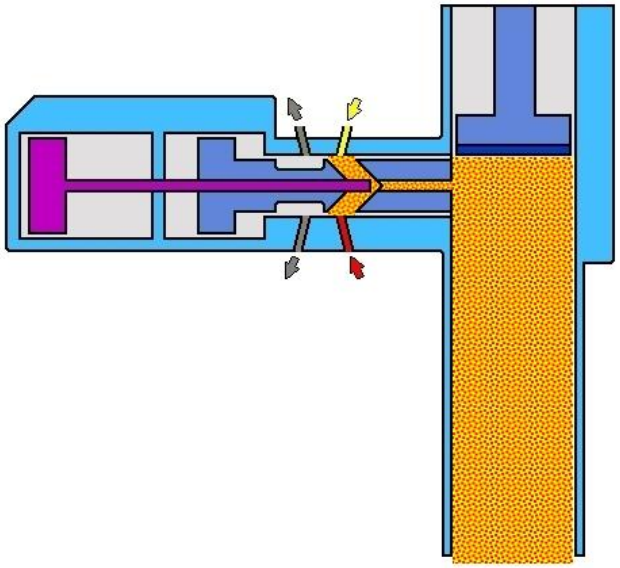
What is it?

- new family of high pressure mixing heads
- based on well-know L-Shaped design
- JL = “Jet Less” = no injectors
- mixing by speed (NO pressure)

Cannon JL High Pressure Mixing Head

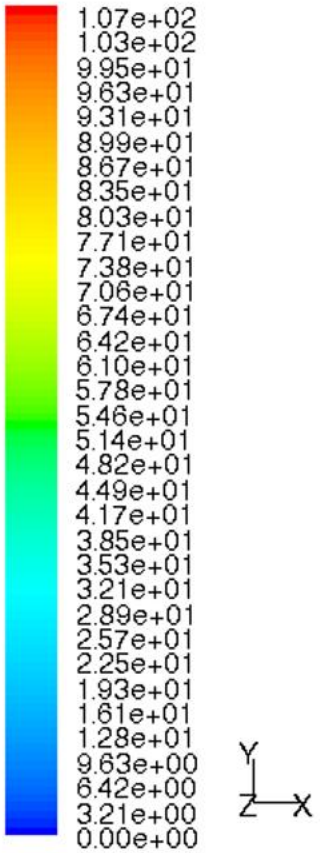
The Sequence

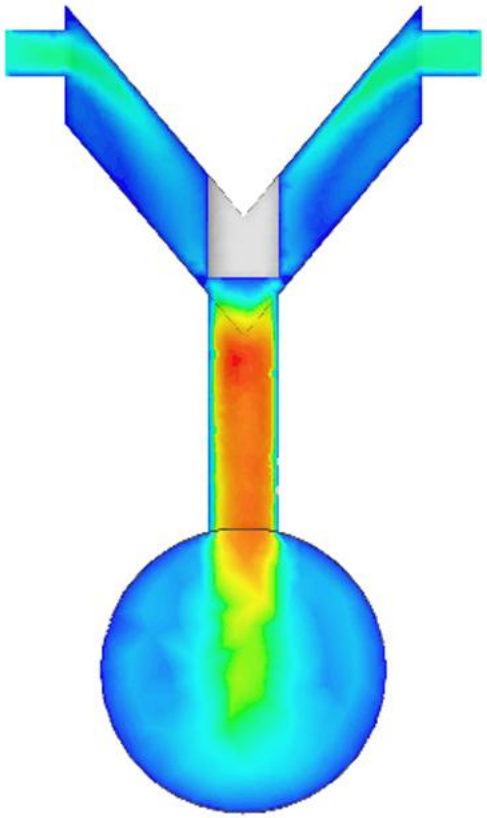




Cannon JL High Pressure Mixing Head

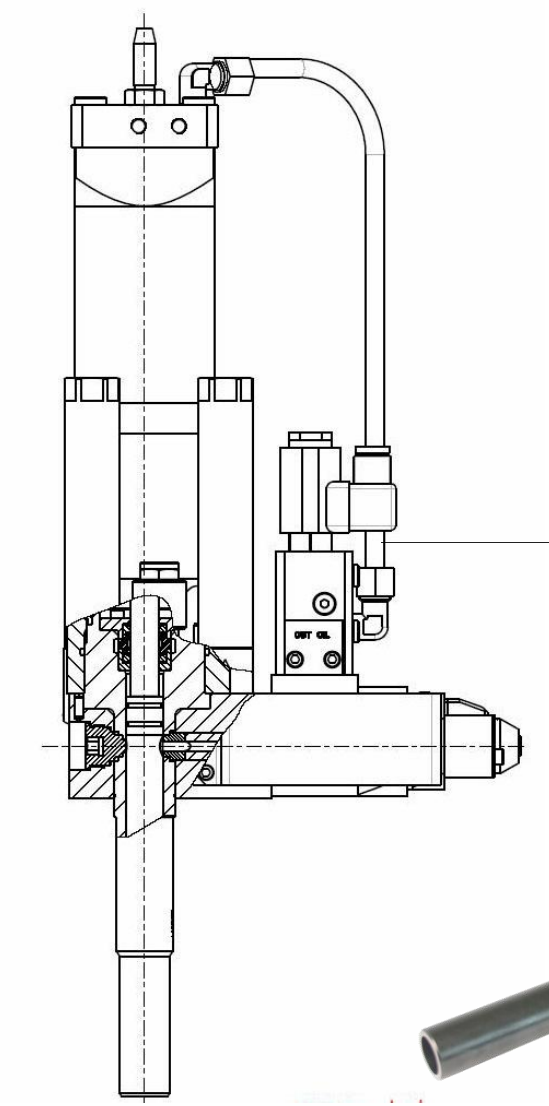
Speed Profile

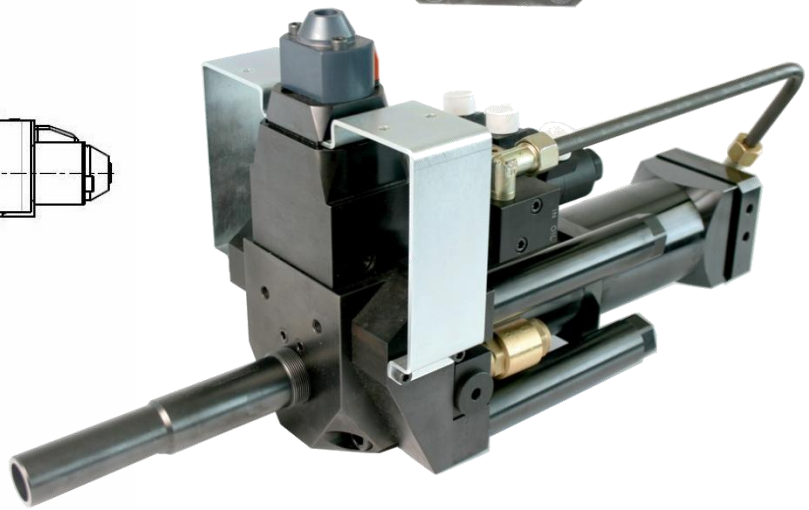




Speed, NOT impingement …

Cannon JL High Pressure Mixing Head





Vacuum Technology

Potential Advantages:

- better cavity filling
- even distribution of density
- uniform cell structure
- blowing agent's reduction
- shorter demoulding time
- better adhesion to metal facings
- NO JETS adjustement

JL 24 1800 cc/s – 100 cm

Innovations: Potential Benefits

- reduced BA consumption (20-30% - estimation)

- better λ (5% - estimation)

- **ENERGY SAVING** (with JL head injection pressure can be significantly reduced

POLYURETHANE TECHNOLOGY

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THANKS FOR YOUR ATTENTION !