



PRACTICAL EXPERIENCES IN THE PRODUCTION
OF INSULATION FOAMS WITH HYDROCARBON
BLOWING AGENT IN DEVELOPING AND
DEVELOPED COUNTRIES

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SAFETY ISSUE WHEN WORKING WITH PENTANES (N-PENTANE, ISO-PENTANE OR CYCLO-PENTANE)

- The conversion to the HC in foam manufacturing in general contains the following steps:
 - (i) design of foam production line,
 - (ii) Construction of the foam Production line, including the HC storage, electric, ventilation, fire protection system etc,
 - (iii) installation of new or retrofitted equipment
 - (iv) trial and commissioning,
 - (v) training ,
 - (vi) Safety audit and
 - (vii) operation and the following safety issues should be considered

SAFETY CONSIDERING

- Cyclopentane is a flammable blowing agent. The explosion limits are 1.1-8.7% by volume in air. Therefore, it is necessary to follow strictly the safety rule.
- Safety at the following steps is required to be considered:
 - - Storage of cyclo-pentane
 - - Mixing of cyclo-pentane and polyol
 - - Storage and metering of mixer
 - - Foaming process

SAFETY REQUIREMENTS WHEN WORKING WITH CYCLO-PENTANE

- The equipment and technology in the converted areas should be inherently safe to avoid any explosion, fire or other hazards during its use (operation, service) in line with the written instruction and training.
- Prevent leaks: All installations should be as tight as possible, pipe connections should be welded
- Avoid explosive mixtures by forced ventilation

SAFETY REQUIREMENTS WHEN WORKING WITH CYCLO-PENTANE

- Do NOT use compressed air for filling, discharging, or handling.
- Use non-sparking hand tools.
- Control ventilation by flow failure detectors
- Control concentrate by pentane detectors: Alarm and increase of extract speed at 20% of LEL, shutdown of electrical power at 40% LEL.

SAFETY REQUIREMENTS WHEN WORKING WITH CYCLO-PENTANE

- Enclose foam dispensing unit and molds in a ventilated booth or box. Sensors below each mold and high pressure pump.
- Avoid ignition sources!
 - Static electricity, parts not grounded
- Prefer central mixing of polyol with cyclo-pentane

SAFETY REQUIREMENTS WHEN WORKING WITH CYCLO-PENTANE

- The polyol mix tank requires:
 - Magnetic joint transmission or
 - liquid barrier,
 - nitrogen pressure,
- Flush the mold or press with nitrogen to bring oxygen content below 10%!
- or test the grounding inside the press and the sandwich panel or refrigerator part to be according the required standard, e.g. 300kV/m

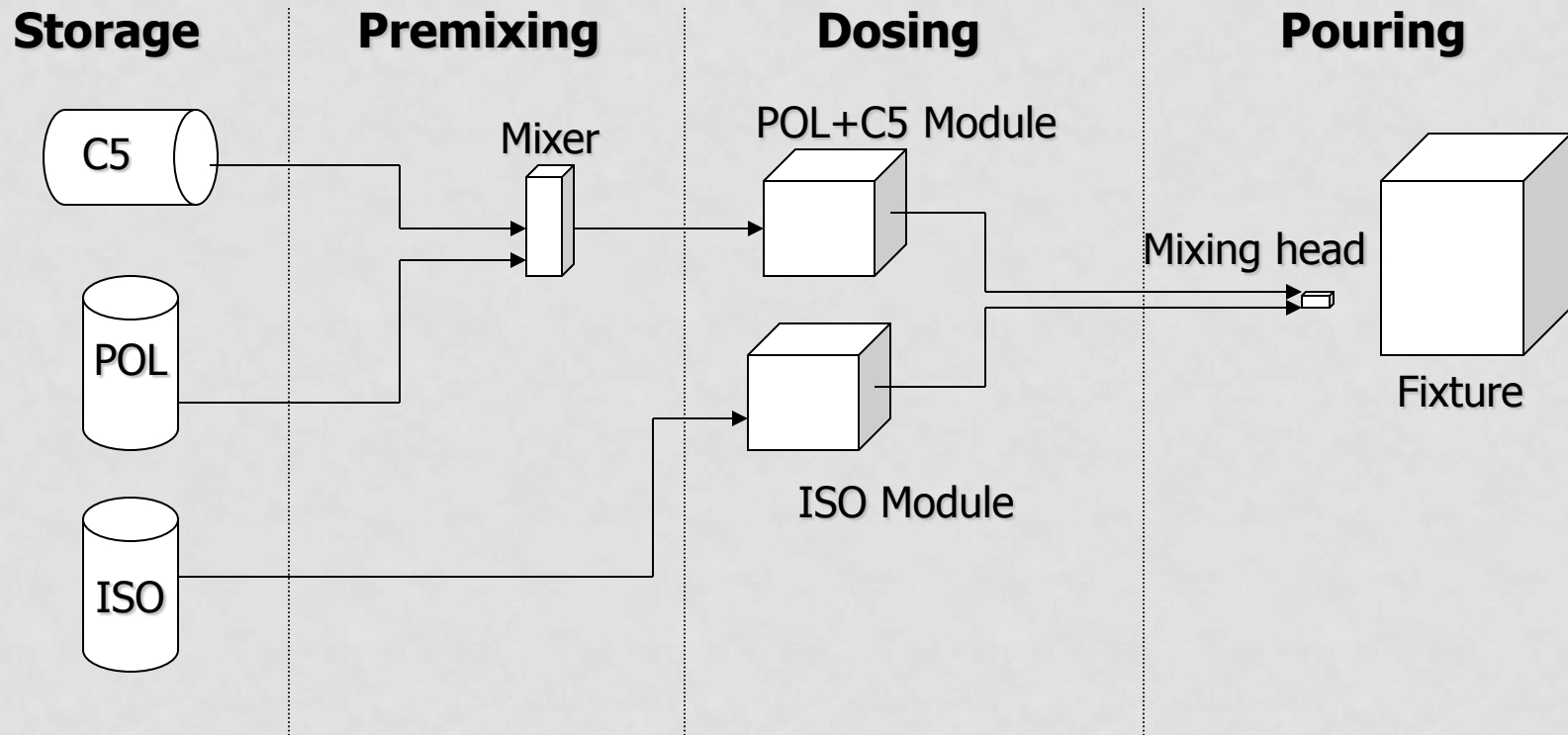
SAFETY WHEN WORKING WITH CYCLO-PENTANE

- During the expansion of the foam in the mold:
 - all non-explosion proof electrical devices in the hazardous areas of the dry part should be automatically switched off;
 - Electrical connections to and from the hazardous areas should be made of fireproof cables

IN THE CASE OF LEAKAGE

- Evacuate danger area!
- Consult an expert!
- Provide ventilation by opening doors and windows. Collect leaking and spilled liquid in sealable containers as far as possible. Absorb remaining liquid in sand or inert absorbent and remove to safe place. Do NOT wash away into sewer. Personal protection: self-contained breathing apparatus.

Schematic composition of the plant





DRUM STORAGE



UNDERGROUND STORAGE



ABOVE GROUND STORAGE



DETAILS 1 GROUNDING



DETAILS 2 GROUNDING TRUCK LOAD CONTAINER



PREMIXING UNIT BY CANNON



PENTANE PREMIXER WITH VENTILATION DUCTING



PREMIXING UNIT BY HENNECKE



VENTILATION UNIT



FLOOR LEVEL VENTILATION DETAILS



GAS SENSOR



GAS DETECTION AND MANAGEMENT



GAS DETECTOR POSITIONING

ANTURI	KANAVA	SIJAINTI
HK1	1	Valukone, halli III
HK2	2	Valukone, halli IV
HK3	3	Valukone, halli V
SLP	4	Pentamaatti
PE	5	Pentaanisäiliö, ulkona
3.1H	6	Halli III, kulmajigien vieressä
3.H	7	Halli III, pumpputason alla
4.H	8	Halli IV, Pentamat - tason alla
5.H	9	Halli V, sekoituspään pylväässä
4.1H	10	Halli IV, V-hallin seinällä, pent.putken alla
4.U	11	Ulkona, IV-hallin päässä (pent.putki katolta)
	12	
	13	
	14	
	15	
	16	

FOAMING MACHINE ENCAPSULATION



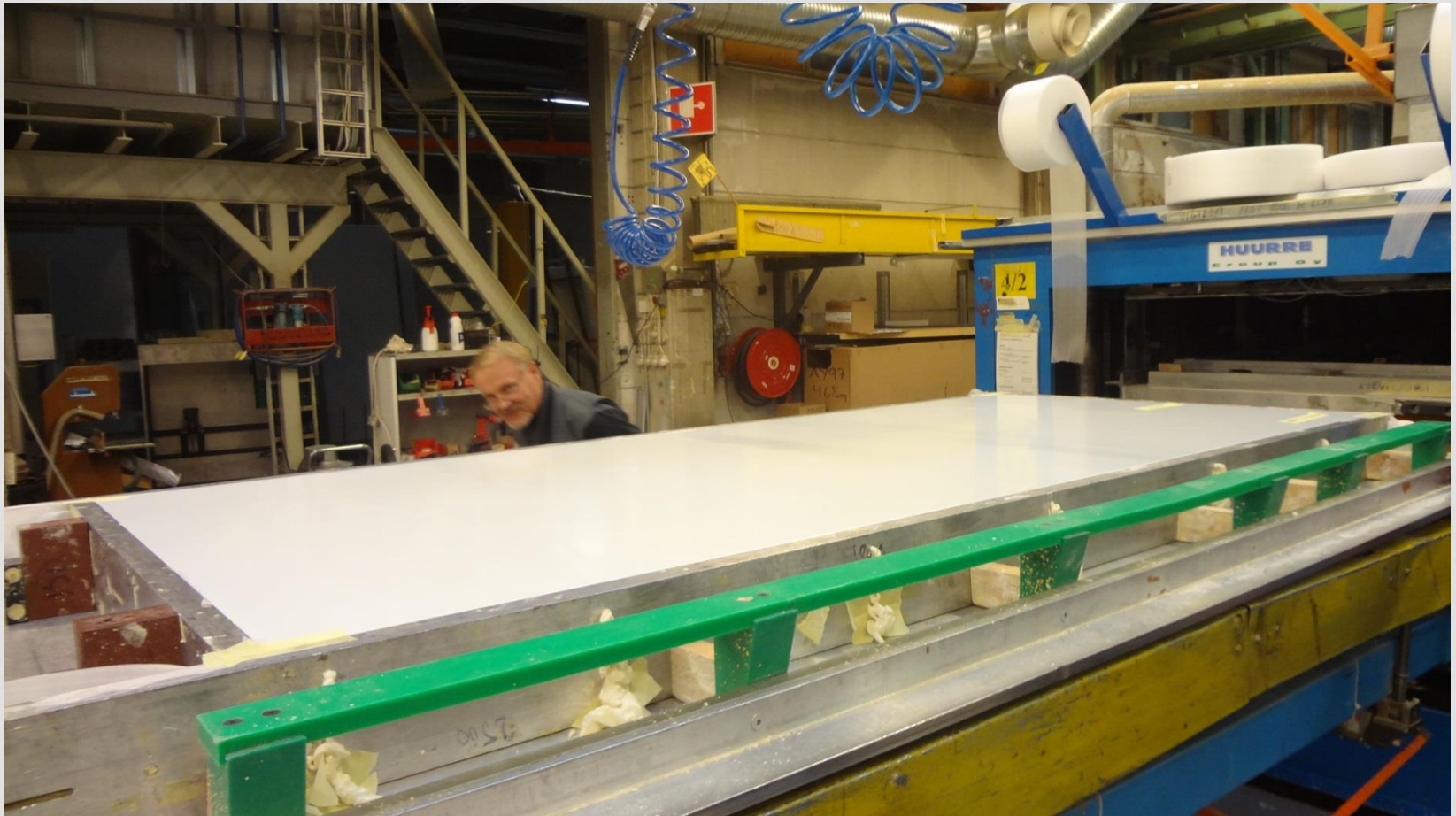
PRESS ENCAPSULATION



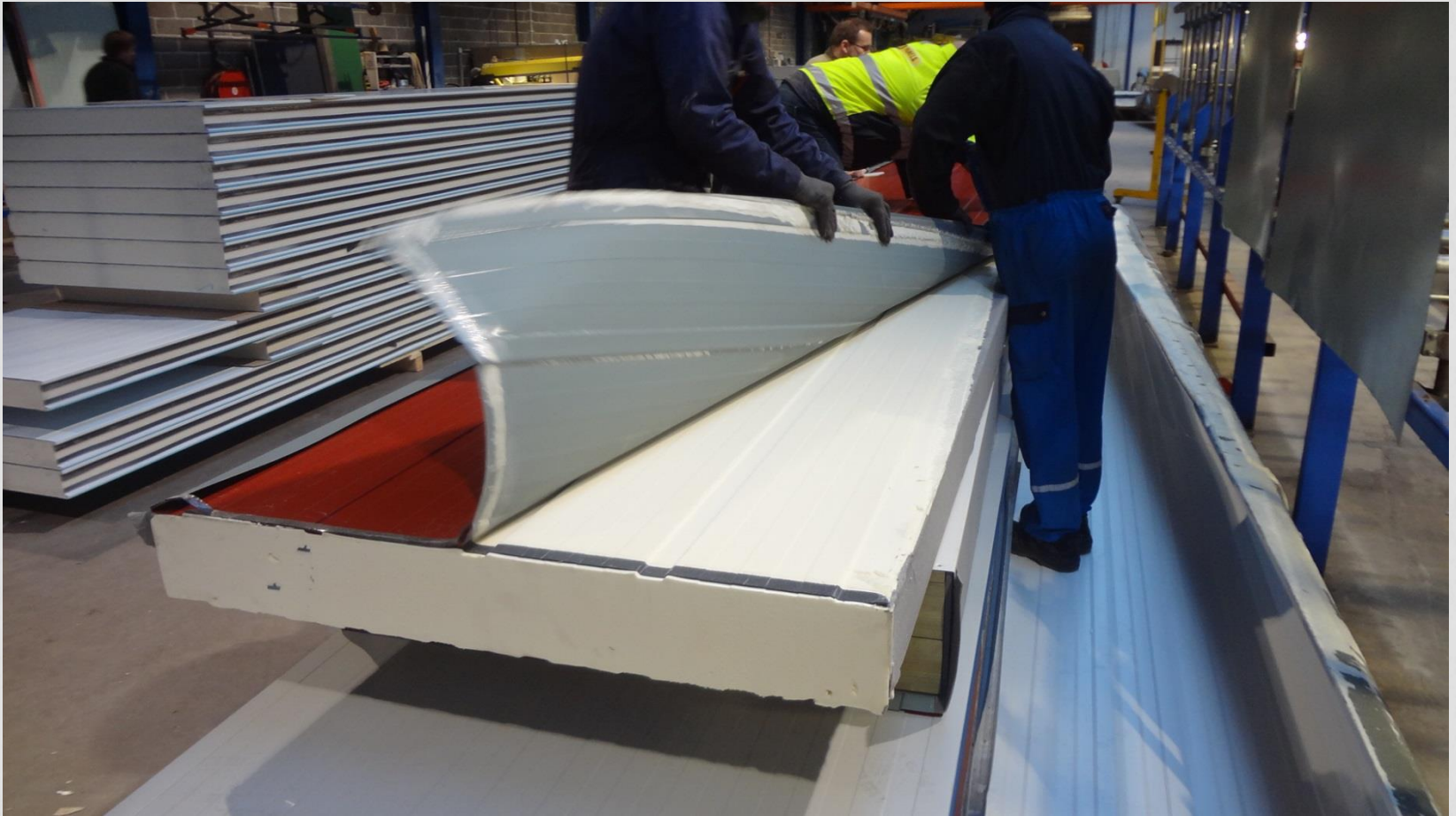
VENTILATION DUCTING



PANEL WITH C-PENTANE



SHOWING GOOD ADHESION



GOOD ADHESION



TESTING VACUUM ASSISTED FOAMING



DOOR DRUM VENTILATION



VENTIATION DUCTING







OTHER SAFETY OBSERVATIONS

- In case of catalytic Gas detectors:
 - Detector and console calibration systematically once per year by professional
 - Infrared are better, but better to have similar systematic calibration procedure
- In hot countries, like in Abu Dhabi, underground tank requires cooling system (I experienced in Abu Dhabi that n-pentane started boiling at the end June, and we had to open the bit and install cooling system)
- Enclosures should be so small as possible

OTHER OBSERVATIONS

- Sandwich panels produced with hydrocarbons tends to be higher in density.
 - Continuous process 5% (liquid density 38-39.5 kg/m³)
 - Discontinuous process over 10% (liquid density 47 kg/m³)
- Discontinuous process can be done more cost effective and safer, if the vacuum assisted foaming can be applied
- Nitrogen flushing can be avoided with proper grounding of the sheet metals in the press



Thank you very much for your attention