



Plast
Industrien

Danish Plastic Federation



Reduction of pentane emission from EPS production

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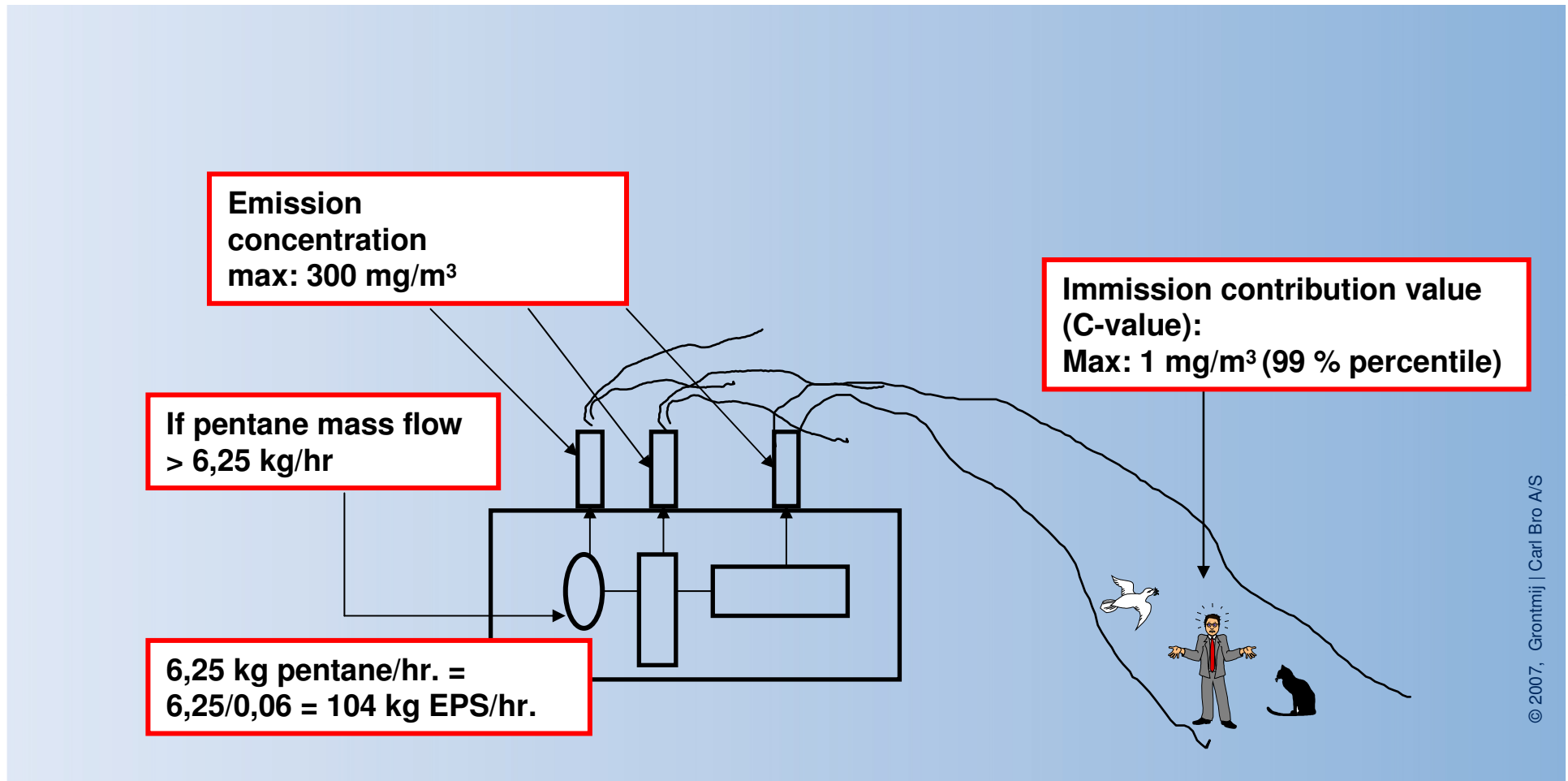


Content

- Danish air pollution regulation for pentane emission
- Regulatory compliance for Danish EPS facilities
- Agreement with DEPA (Danish Environmental Protection Agency)
- EPS pentane project – activities and project plan
- Results from TOC measurements from two facilities
- Survey of reduction methods (end of pipe solutions)
- Incineration of pentane, technique, economy and safety
- Pilot project



Danish air pollution regulation for pentane emission



Regulatory compliance for EPS facilities



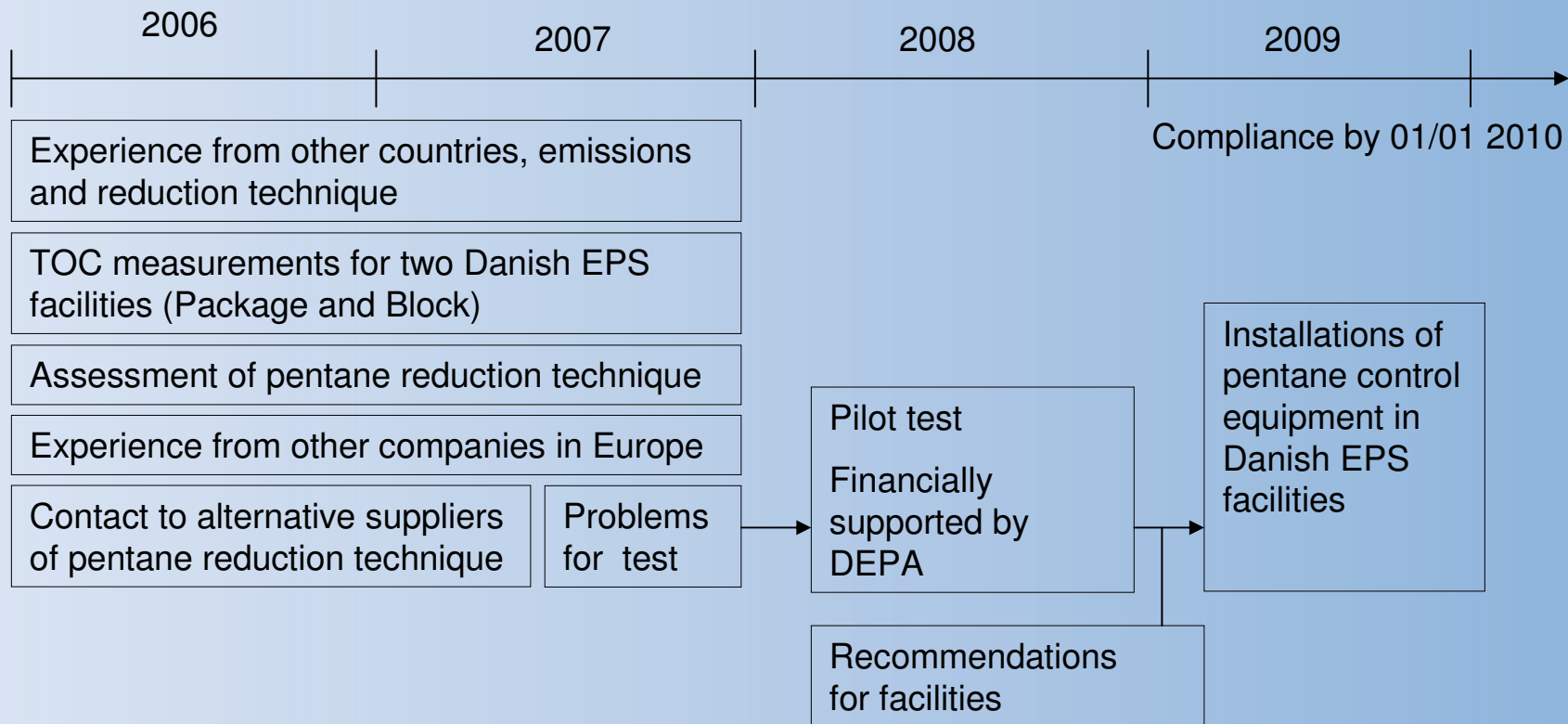
Facility	Categori	< 300 mg/m3	> 300 mg/m3	Compliance
1	Large Package		X	NO
2	Medium Package	(X)	(X)	?
3	Medium Package		X	NO
4	Medium Block		X	NO
5	Large Package		X	NO
6	Small Package		X	NO
7	Medium Block	(X)	(X)	?
8	Large Block		X	NO
9	Large Block		X	NO
10	Large Block		X	NO
11	Medium Package		X	NO
12	Medium Package		X	NO
13	Large Block		X	NO

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Agreement with DEPA

Project to find best practical and economic solution for pentane reduction

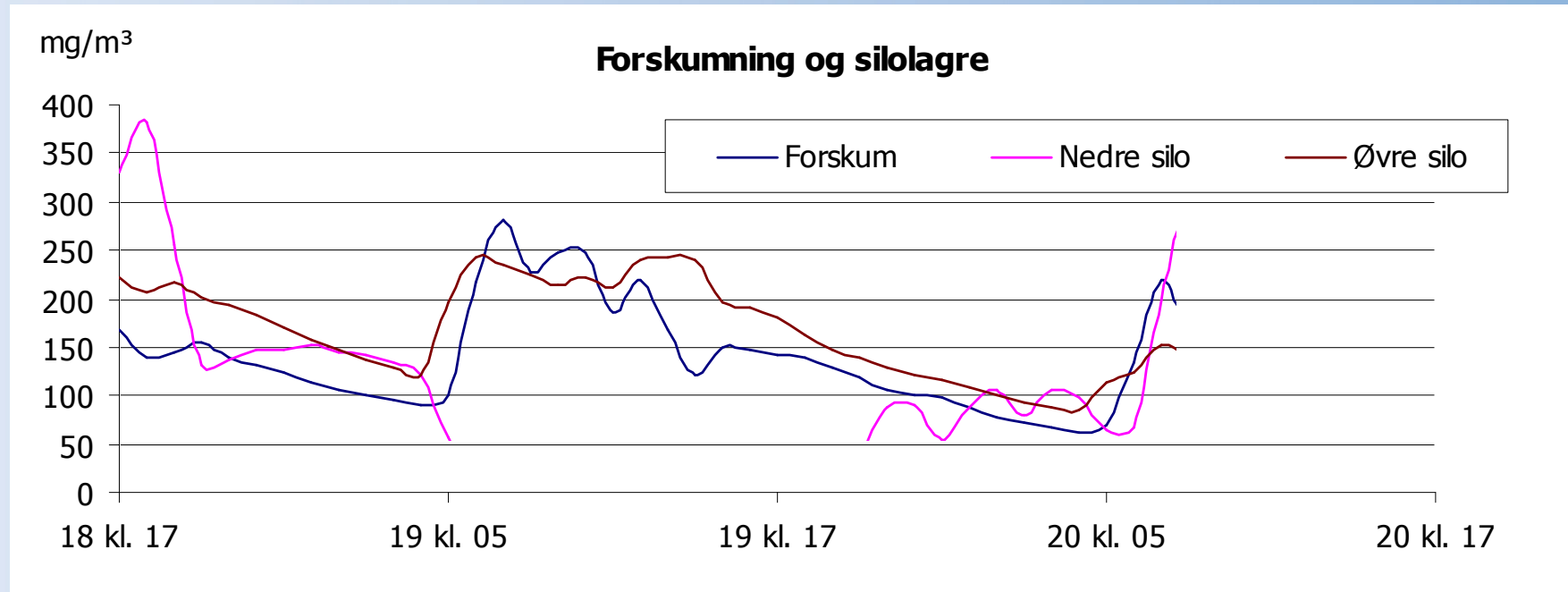


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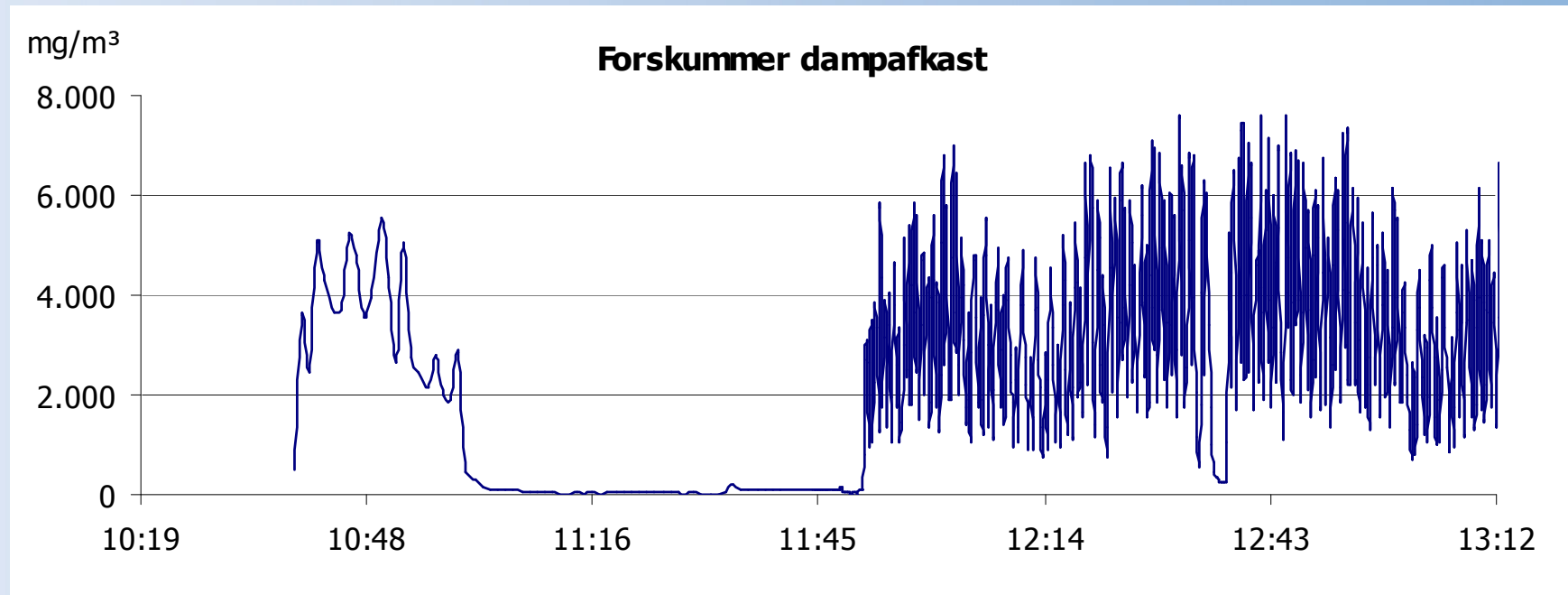
TOC measurements

Example from EPS Package production - preexpander and aging storage



TOC measurements

Example from EPS Package production - preexpander

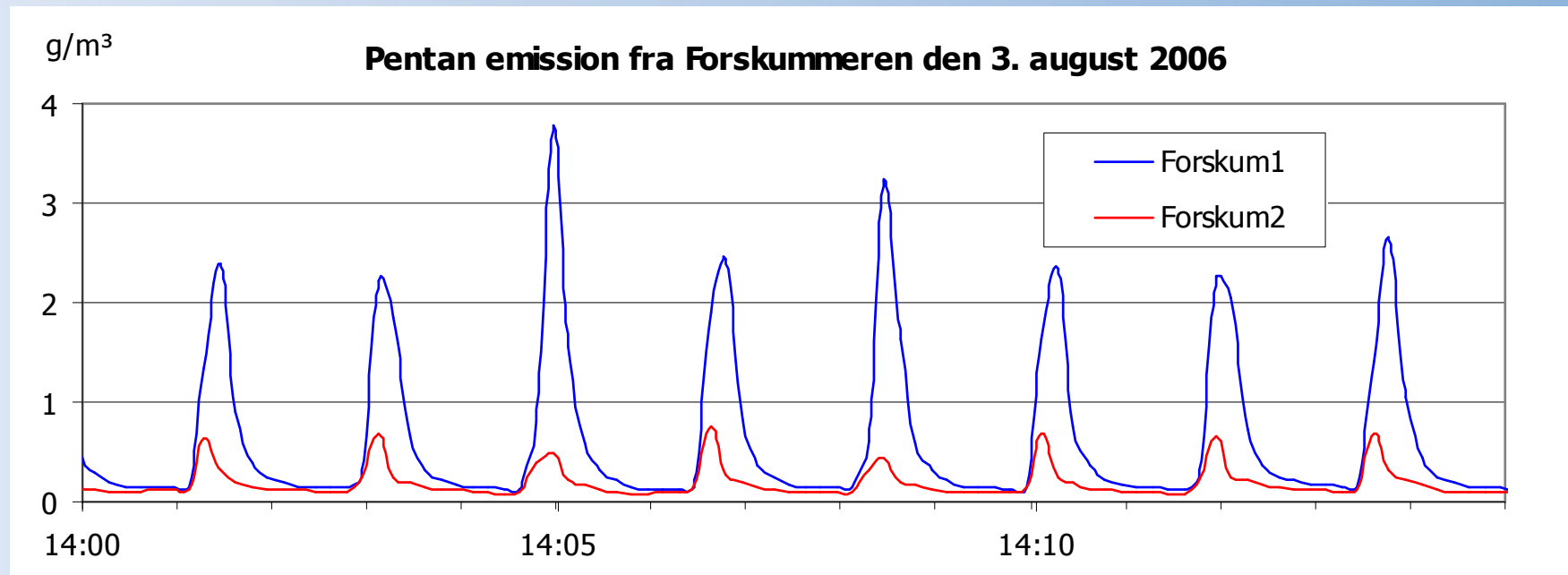


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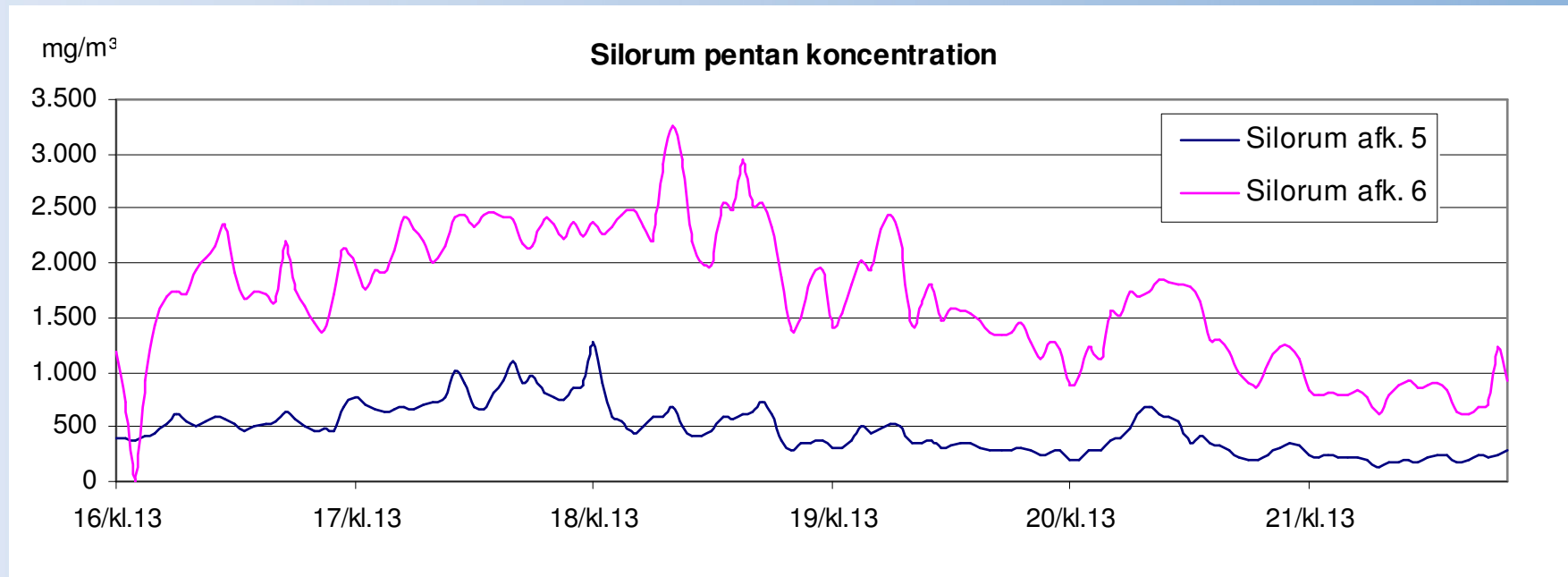
TOC measurements

Example from EPS Block production - preexpander



TOC measurements

Example from EPS Block – aging storage

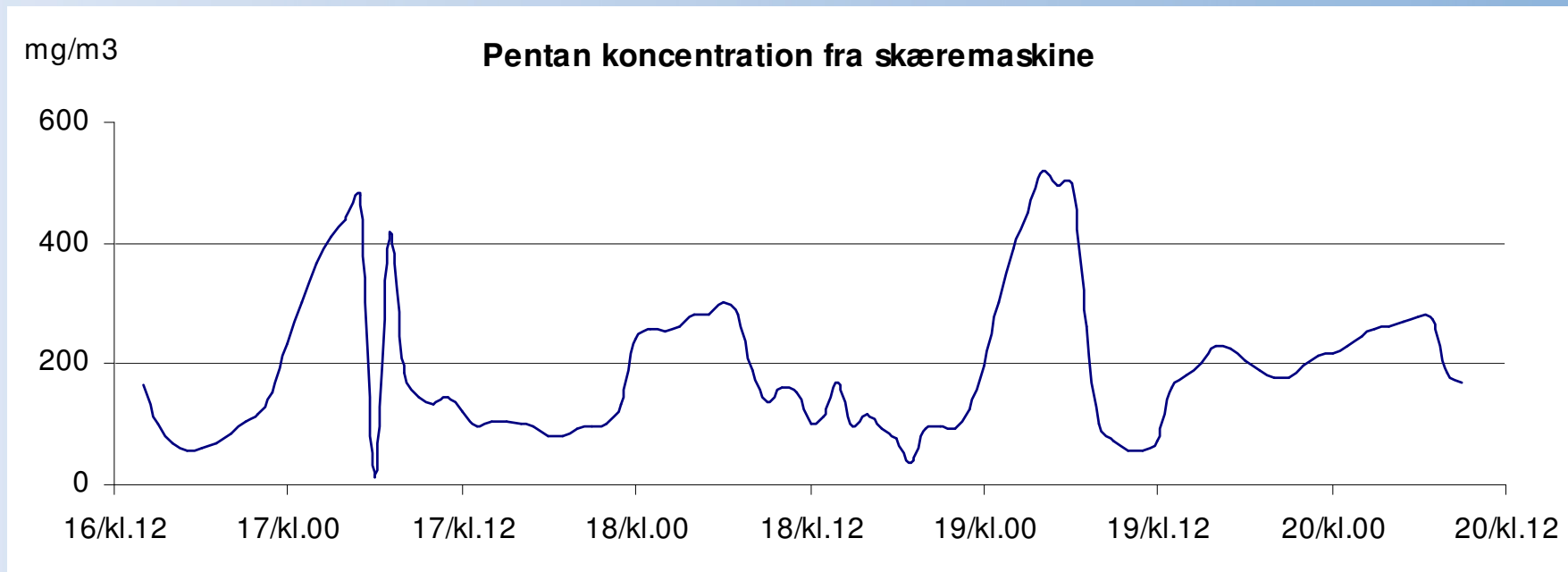


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TOC measurements

Example from EPS Block – cutting machine



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EPS Package

300 kg EPS/hr. = 300 x 0,06 = 18 kg pentan/hr.

Source	% of content in raw material	Pentan emission Kg /hr.	Air flow m ³ /time	Conc. mg/m ³	% af LEL (41.500 mg/m ³)
Preexpander	25	4,5	2.000	2.250	6
Aging storage	20	3,6	2.000	1.800	4
Molding	15	2,7	2.000	1.350	4
Room ventilation	15	2,7	10.000	270	
Left in product	25	4,5			
TOTAL	100	18			
Total - room ventilation - in product	60	10,8	6.000	1.800	5

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EPS Block

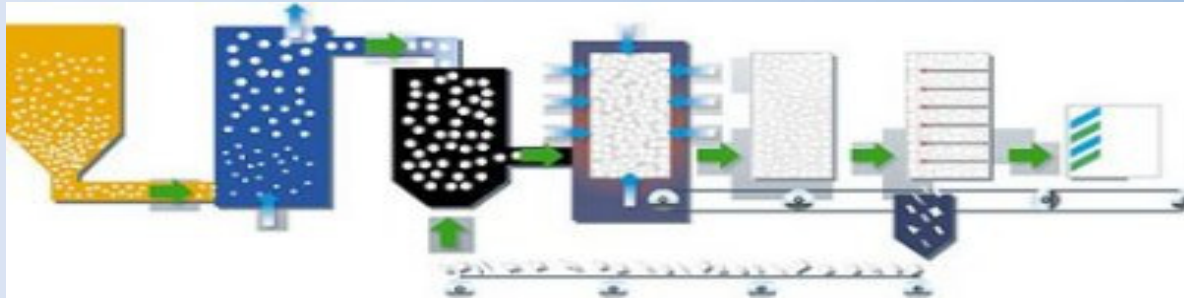
1.000 kg EPS/hr. = 1.000 x 0,06 = 60 kg pentan/hr.

Source	% of content in raw material	Pentan emission Kg /hr.	Air flow m ³ /time	Conc. mg/m ³	% af LEL (41.500 mg/m ³)
Preexpander	35	21	5.000	4.200	10
Aging storage	10	6	4.000	1.250	3
Molding	15	9	2.000	4.500	11
Room ventilation	10	6	20.000	300	
(Cutting)	5	3	2.000	1.250	
Left in product	25	15			
TOTAL	100	60			
Total - room ventilation - in product, - cutting	60	36	11.000	3.300	8

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Conclusion of TOC measurements



Pentane distribution

Source	Package % of content in raw material	Block% of content in raw material
Preexpander	25	35
Aging storage	20	10
Molding	(15)	15
Room ventilation	15	10
Cutting		5
Left in product	25	25
Possible reduction	45-60	60

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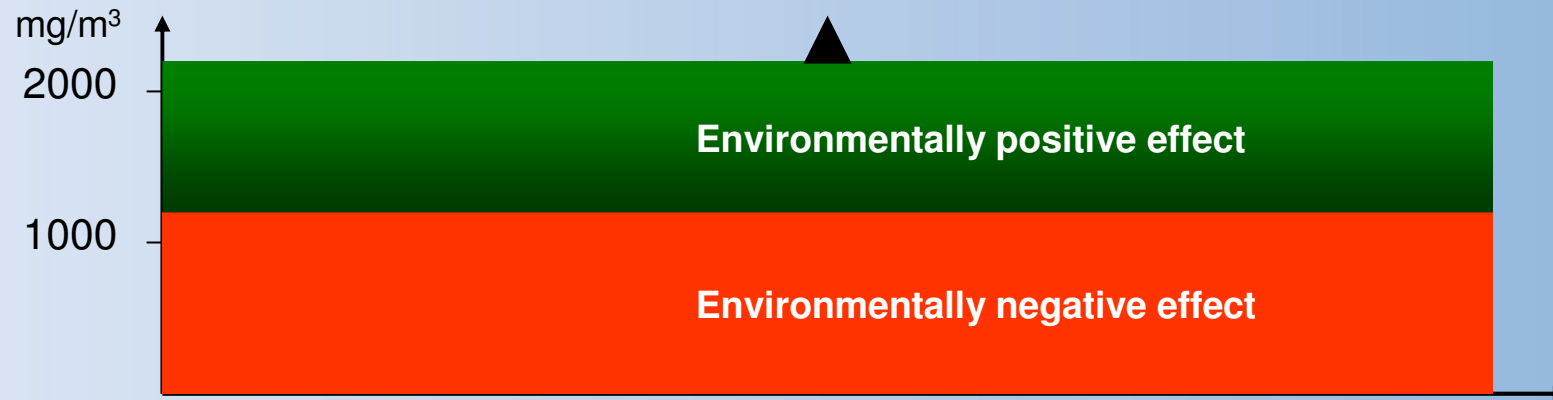


Assessment of pentane reduction techniques

Technique	Usefulness (efficiency, economy)	Risk assessment
Scrubbers	-	+
Carbon adsorbtion without regeneration	-	+
Carbon adsonbtion with regeneration	-	-
Bio filters, dry and wet systems	-	+
UV-ozone treatment	-	+
Thermal incineration	-	+
Thermal incineration combined with air recycling	+	-
Catalytic incineration	(+)	+
Thermal regenerative incineration	+	+
Thermal regenerative incineration with zeolite concentration unit	(+)	+



LCA assessment of thermal inceneration

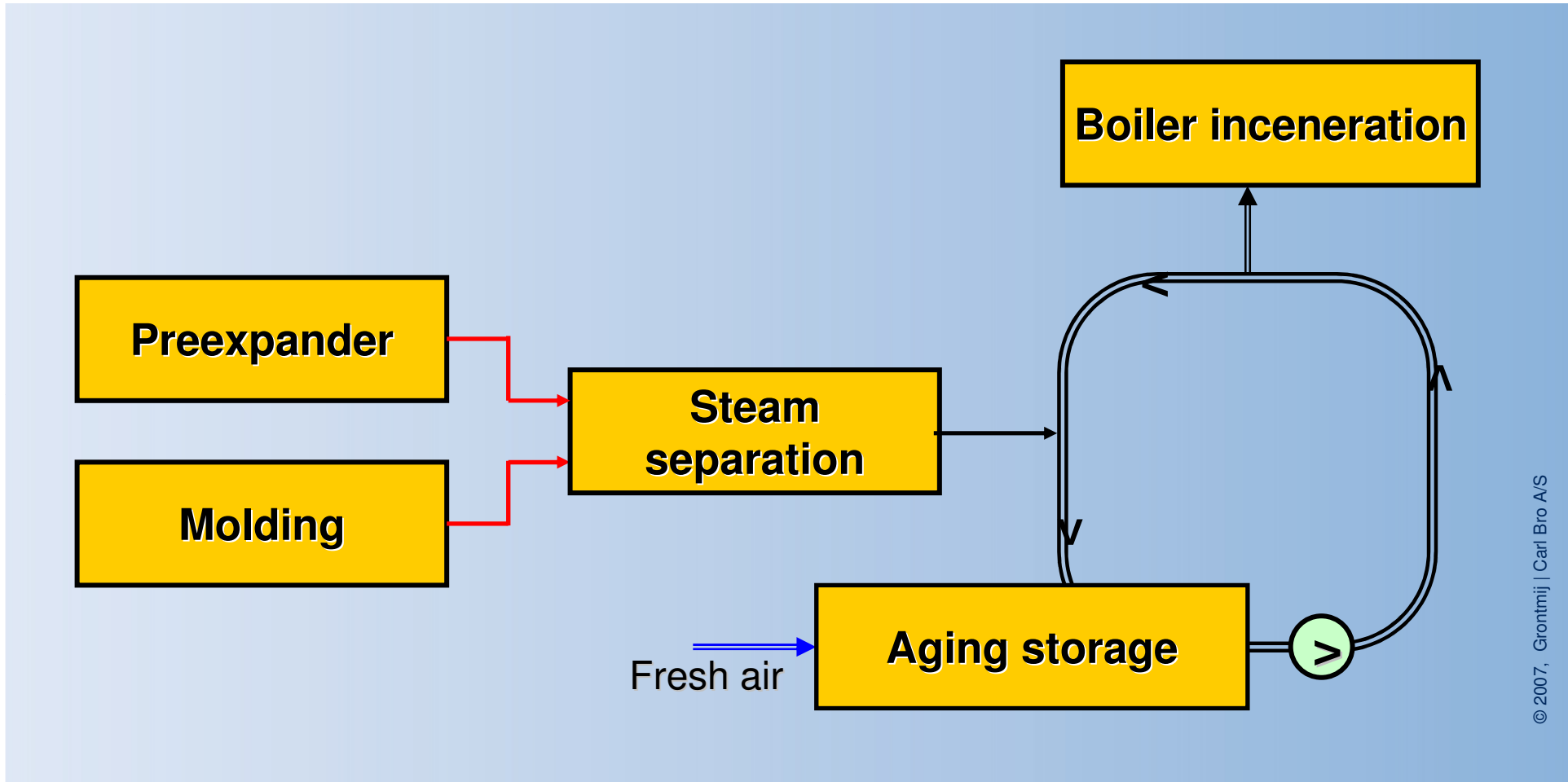


Assessment of techniques used in USA and Europe to reduce pentane emissions

- 1. Recirculation over aging silo; concentration increase and reduction of air flow followed by incineration in steam boiler**
- 2. Thermal regenerative incineration**



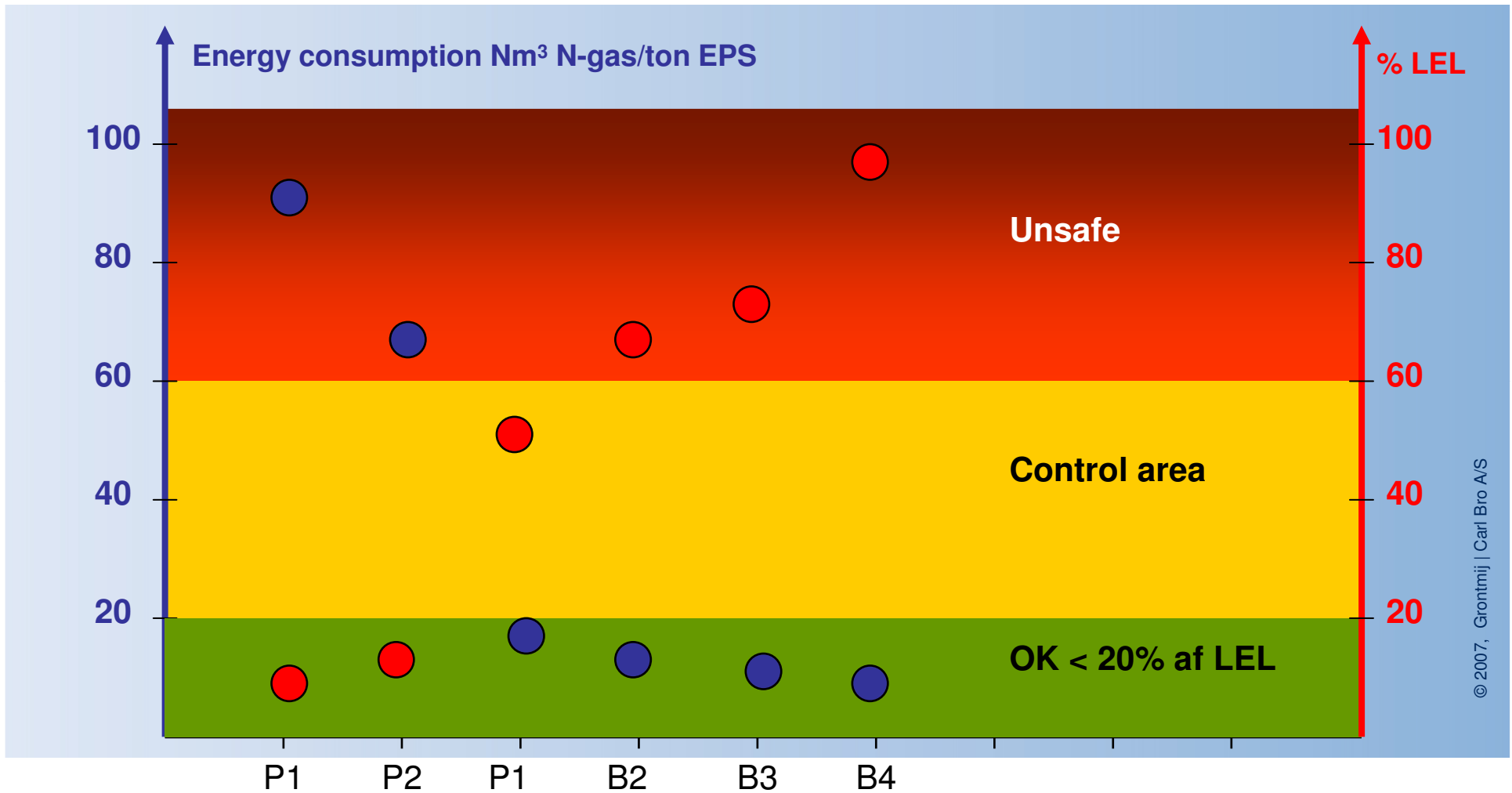
Assessment of recirculation over aging storage



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Recirculation over silo storage – example for 6 facilities



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Assessment of recirculation over aging storage

Conclusion:

Method only usefull for closed un-manned aging storage systems

Method not usefull for Danish faciliteis due to high pentane concentrations

High pentane concentrations are caused by high energy efficiency



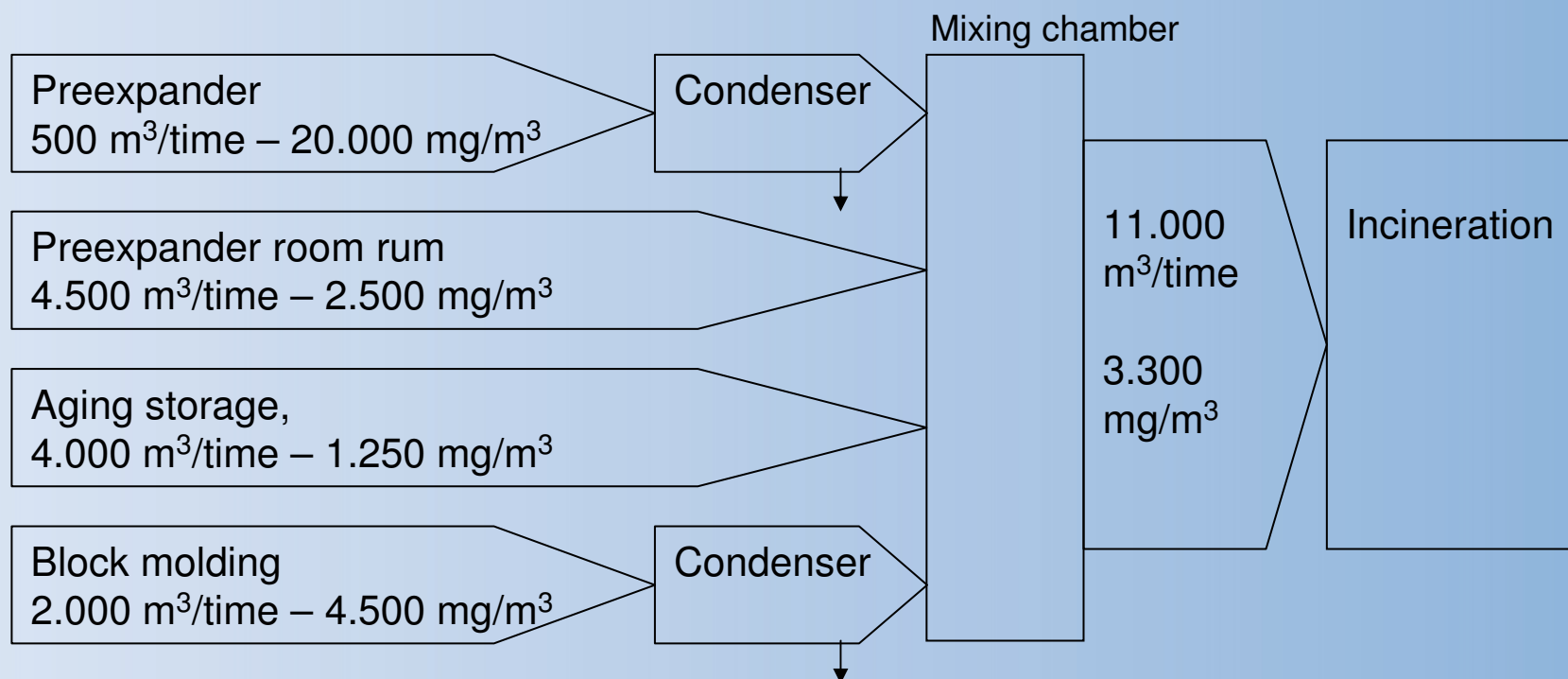
Autothermal conditions for incineration

- **Catalytic > 600 mg/m³**
- **Thermal regenerativ > 1400 mg/m³**
- **Thermal (for example in boiler) (without internal heat recovery)) (f.eks. i egen kedel) > 20000 mg/m³ – Risky (LEL = 41000 mg/m³)**

Concentrations < 600 mg/m³: use of zeolite based concentration unit



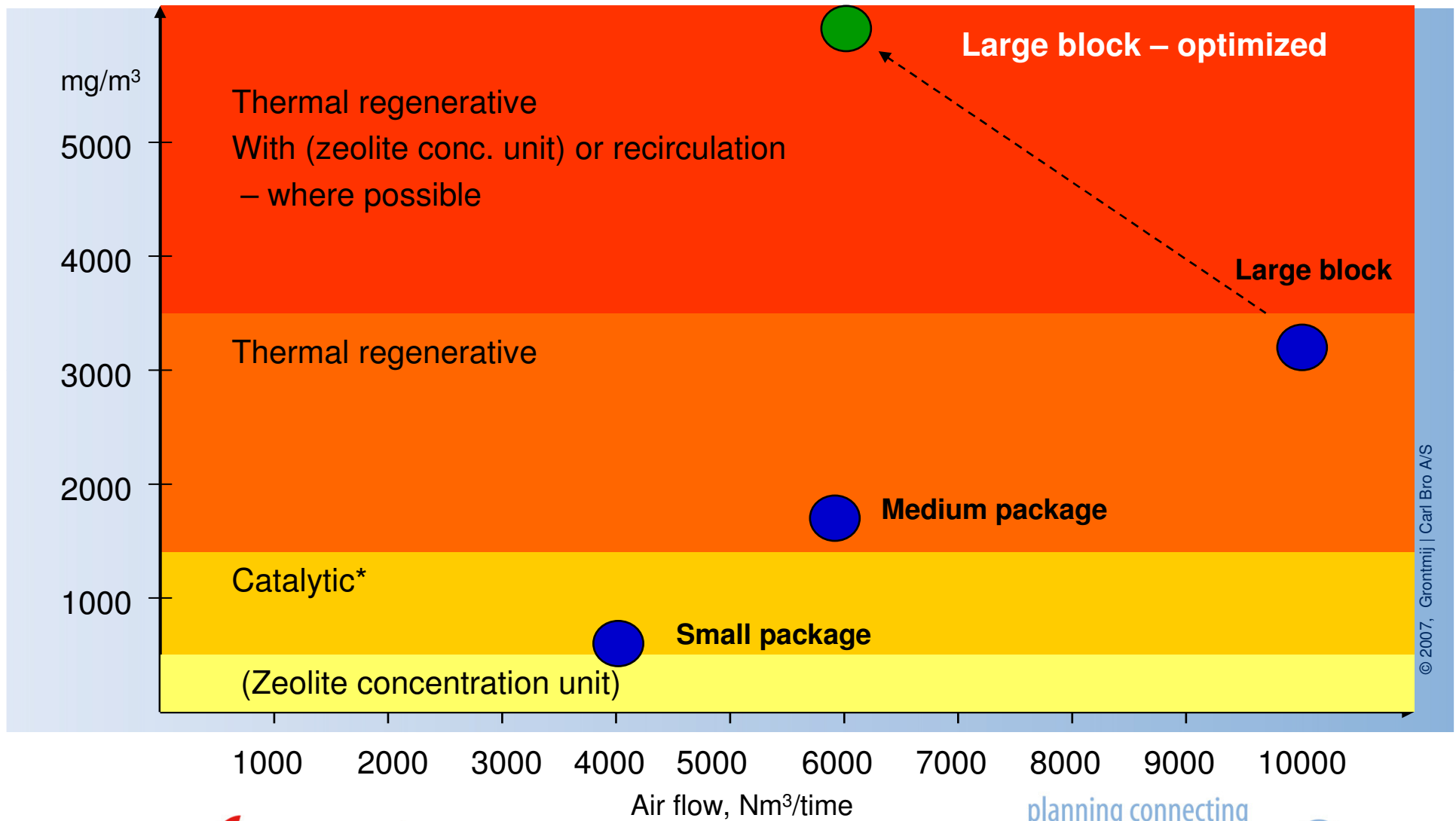
Eksample with large block production
1.000 kg EPS/hr. = 1.000 x 0,06 = 60 kg pentan/hr.



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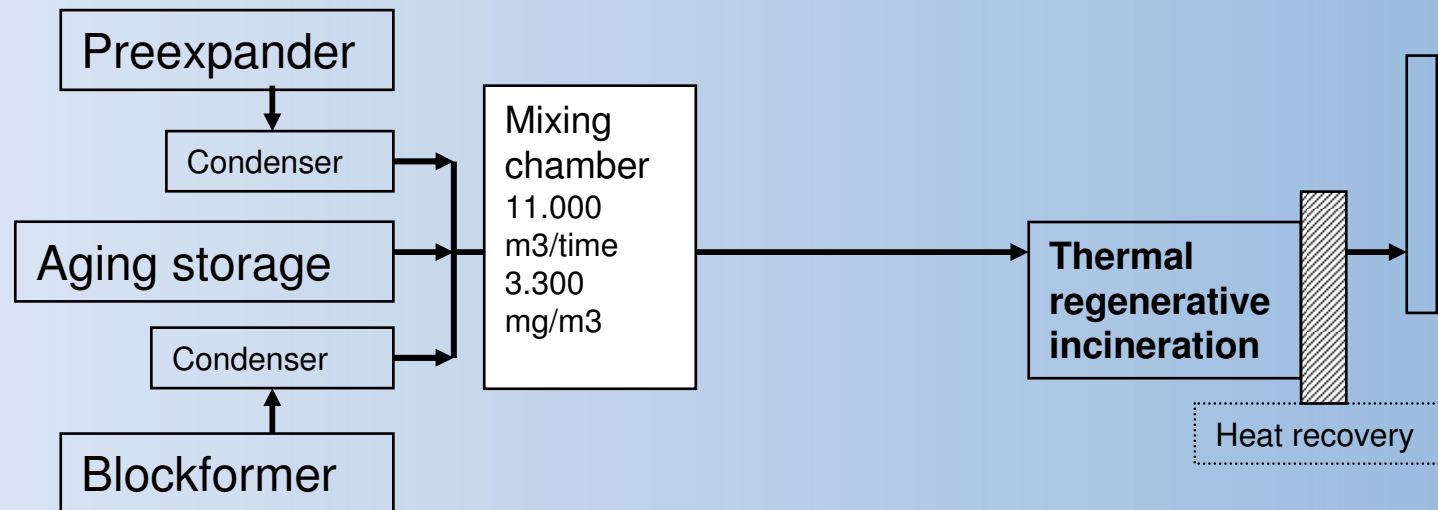


Thermal reg. and catalytic inceneration



Block production

– example with thermal regenerative incineration



Special issues to test:

- Concentration management 2.000-10.000 mg/m³ under production and in weekends
- Condensation of water – risk of water pentane mixtures
- Filtering to prevent dust from blocking regenerative unit

