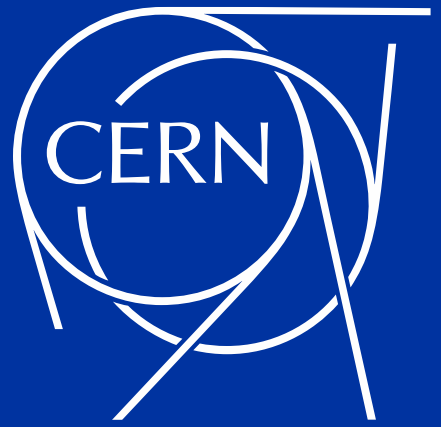


GWT _ Options for Surface Finishing

Leonel Ferreira on behalf of CERN TE-VSC-SCC

Beampipes for Gravitational Wave Telescopes 27-29 March 2023_CERN/Switzerland

Content

Surface Finishing (SF) & GWT

CERN & ET: Cleaning activities

Concept for ET series pipes cleaning machine

Surface Finishing (SF) & GWT

Surface specifications

Low degassing surfaces

- low amount of organic contamination

- low water/surface binding energy

- low roughness

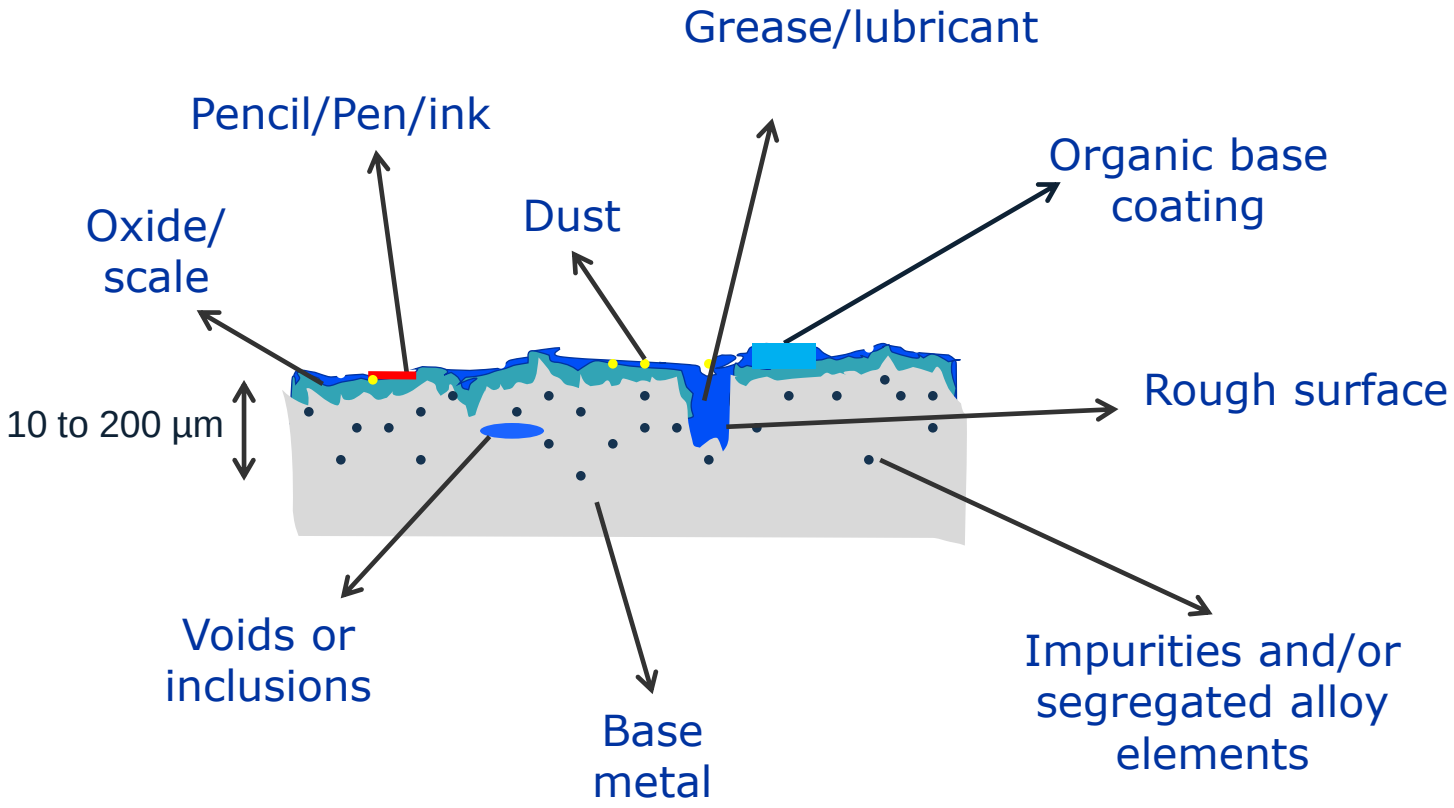
Low yield of particulates

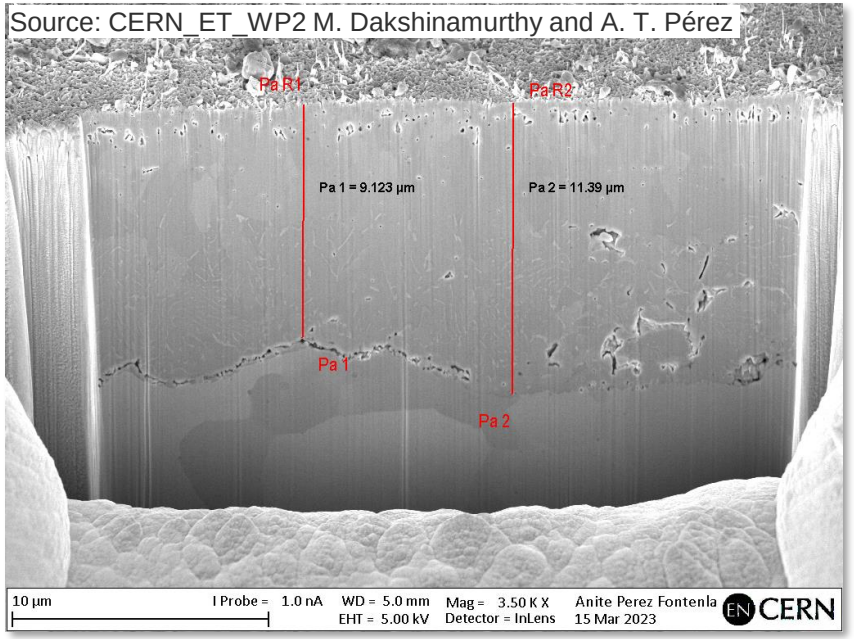
- low amount of particulate contamination

- low particulates yielding surface

Surface Finishing (SF) & GWT

Pipe raw material cleaning





Surface Finishing (SF) & GWT

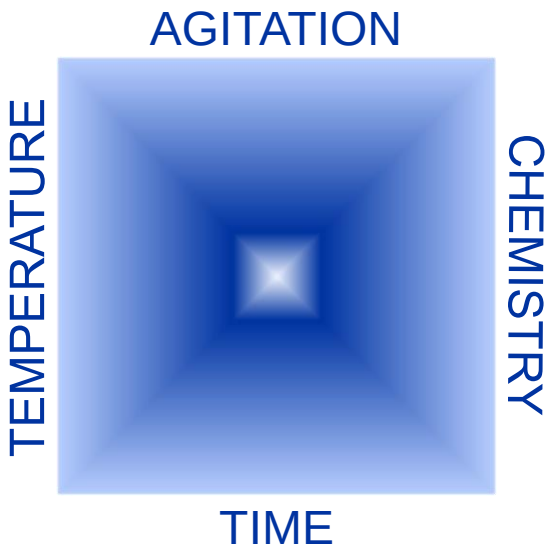
Pipe cleaning

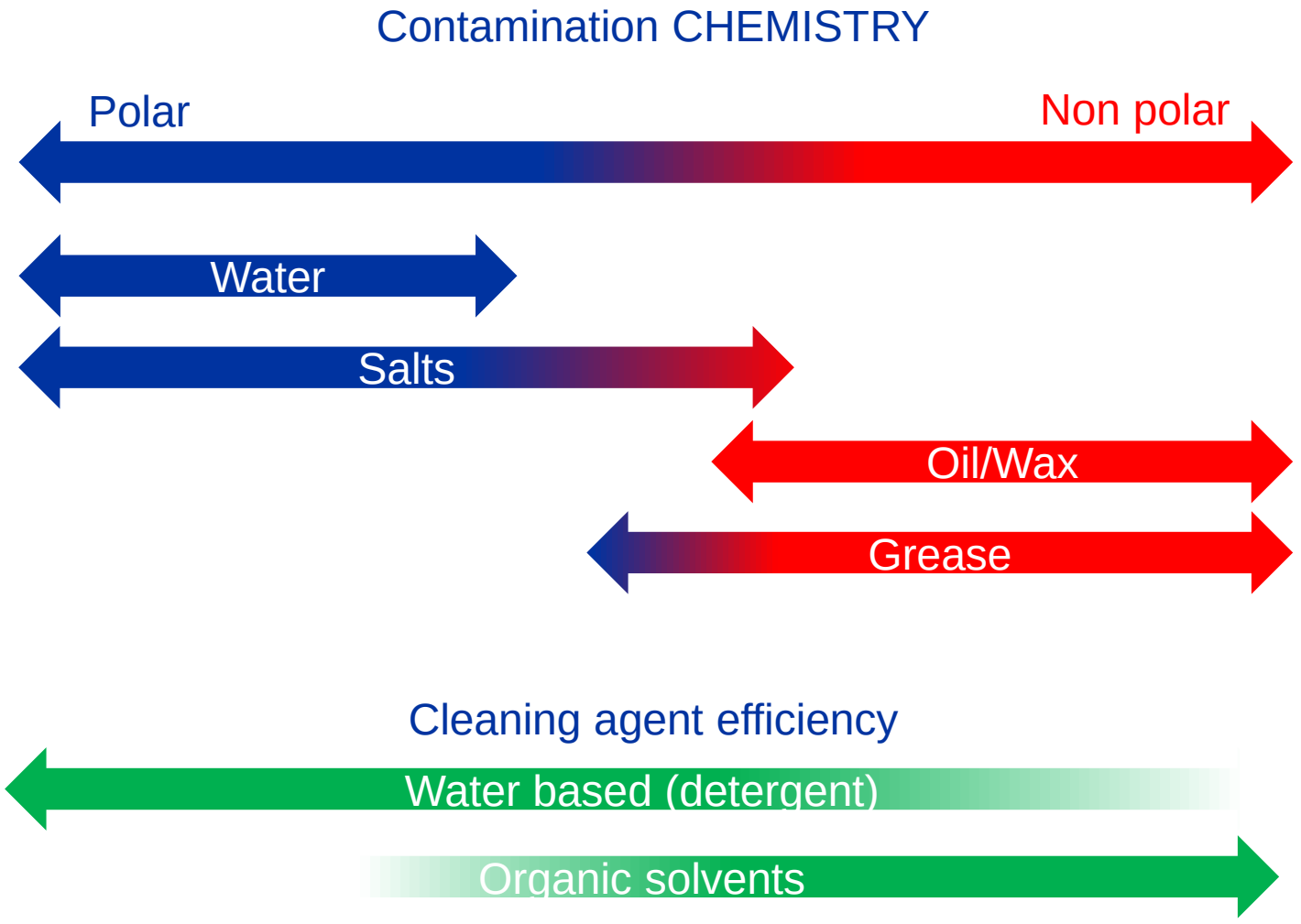
Surface Finishing

- Water based
  - Degreasing: Removal of organic contamination
  - Pickling: Removal of oxide layer
  - Etching: Removal of damaged layer
  - Polishing: Removal of damaged layer with polishing finishing
  - Passivation: Formation of protective layer against corrosion
  - Coating: Functional layer: corrosion protection / low degassing
- Organic based
  - Degreasing: Removal of organic contamination
  - Passivation: Formation of protective layer against corrosion
  - Coating: Functional layer: corrosion protection

Surface Finishing (SF) & GWT

Degreasing



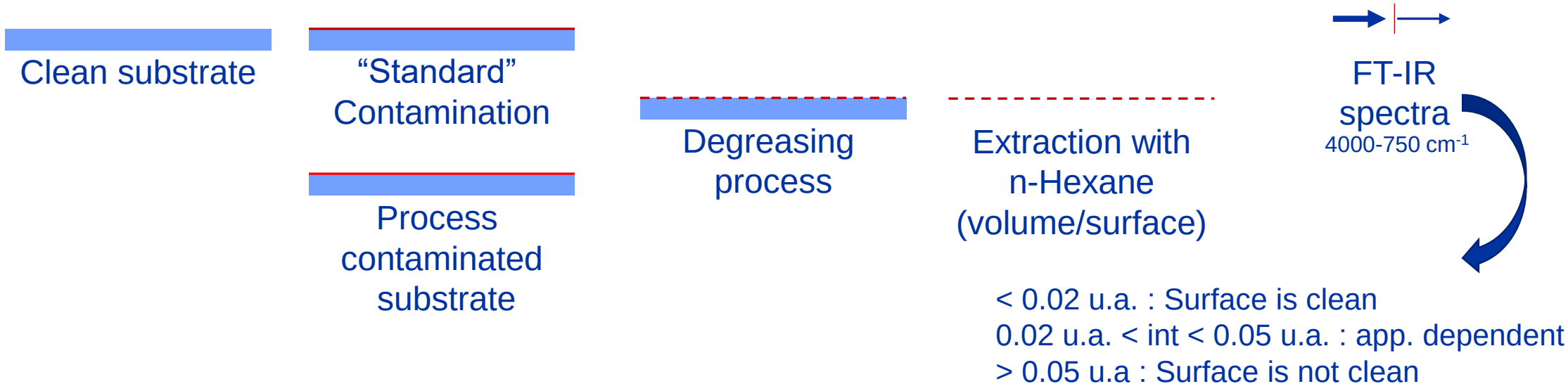


Surface Finishing (SF) & GWT

Cleaning process & Cleanliness assessment (CERN procedures)

FT-IR spectroscopy:

- Identification (HC vs Silicone based) and quantification of organic based contamination
- On samples and on parts



Surface Finishing (SF) & GWT

Cleaning process assessment (CERN procedures)

XPS:

- Elemental composition of the surface (H excepted)
- Depth 5 to 10 nm
- Lateral resolution ~1 mm
- On samples only

Clean substrate

"Standard" Contamination

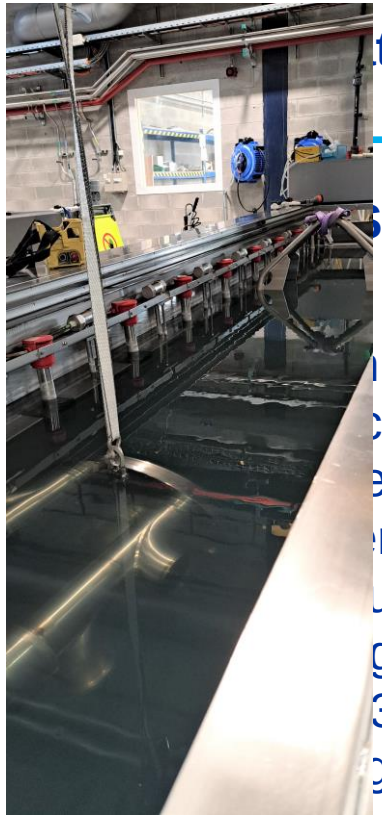
Process contaminated substrate

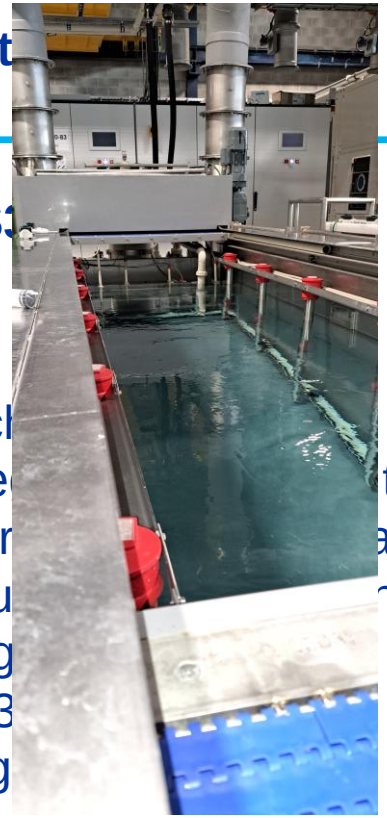
Degreasing process

Element	Maximum allowed quantity **on stainless steel**	
C	ESCA5400: 46.3 at.%	SPECS: 31.3 at.%
Zn	Below detection limit (ESCA5400: 0.5 at.%, SPECS: 0.1 at.%)	
Cd	Below detection limit (ESCA5400: 0.5 at.%, SPECS: 0.1 at.%)	
Cl	ESCA5400: 2 at.%, SPECS: 1.5 at.%	
F	ESCA5400: 2 at.%, SPECS: 1.5 at.%	
S	ESCA5400: 2 at.%, SPECS: 1.5 at.%	
Na	ESCA5400: 2 at.%, SPECS: 1.5 at.%	
K	ESCA5400: 2 at.%, SPECS: 1.5 at.%	
Ca	ESCA5400: 2 at.%, SPECS: 1.5 at.%	
Others	Any additional element must be reported	
Others specific for the application		
	The total amount of Cl, F, S, Na, K, Ca and additional elements should not be larger than 10 at.% (ESCA5400) and 7.5 at.% (SPECS), respectively	

CERN & ET: Cleaning activities

“Cleaning” procedures for pre-prototyping pipes (400 mm Ø x 2100 mm L)





for 1 hour

Packing: PE bag

CERN & ET: Cleaning activities

"Cleaning" of the pilot sector (~ 2x 1200 mm Ø x 50000 mm L): 2nd Semester 2024

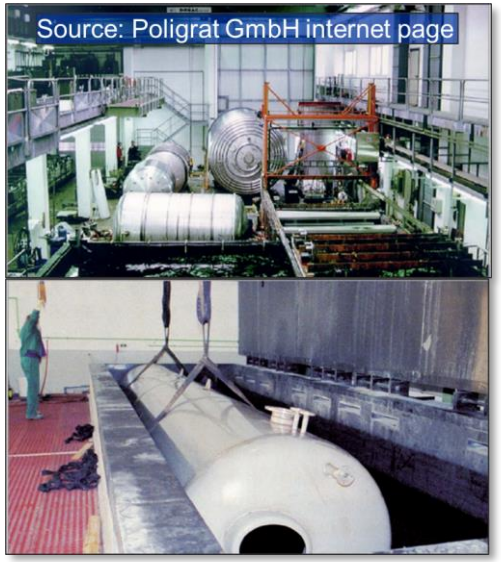
CERN is not equipped to process parts with 1.2 m Ø.

Outsourcing:

- Direct service providers:
  - Poligrat GmbH
  - JettyRobot s.r.o.

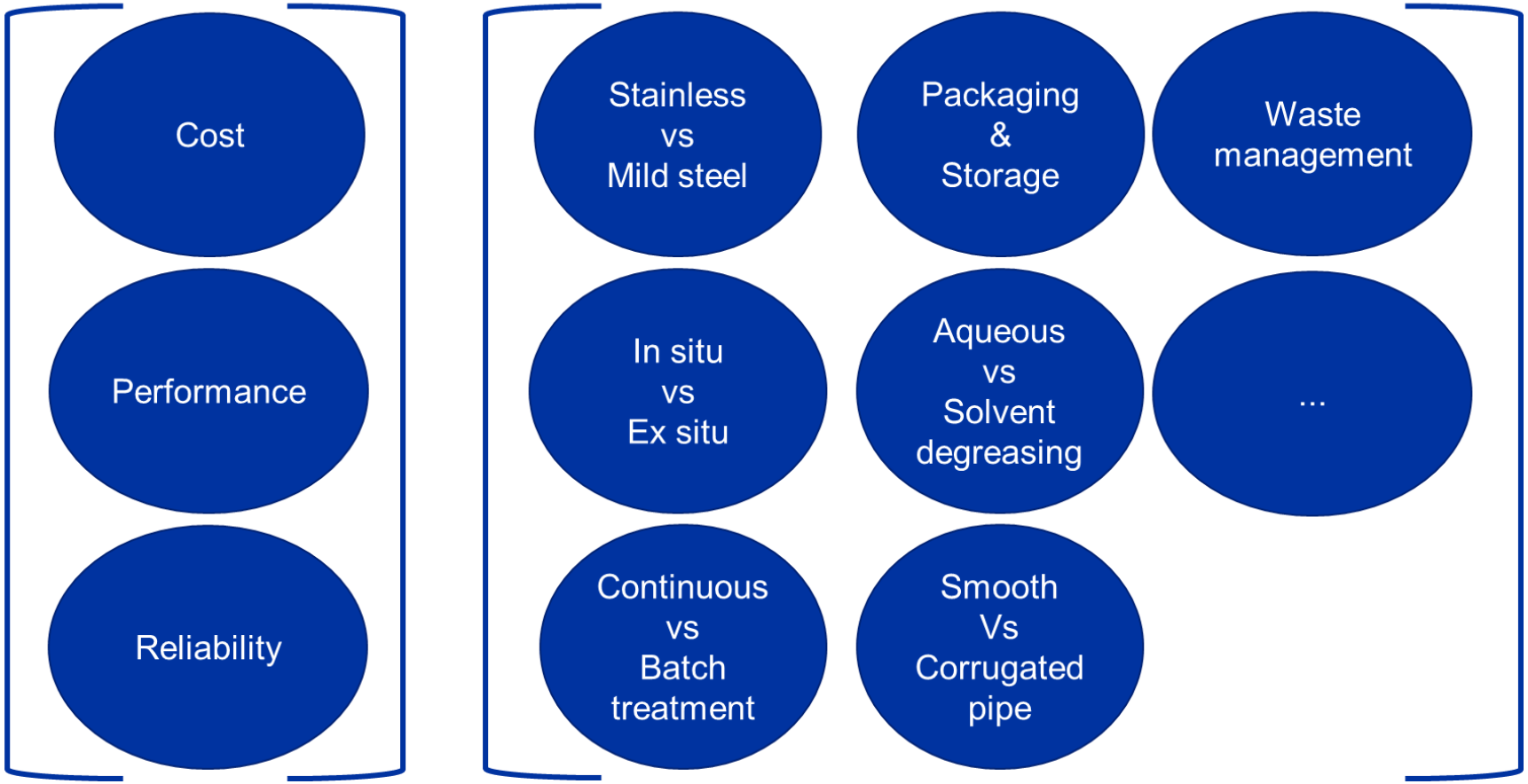
To be assessed

Other contacts through manufacturers of cleaning facilities:
ECOCLEAN GmbH
HEMO GmbH
Firbimatic Spa



Concept for ET series pipes cleaning machine

Assessment matrix…



Concept for ET series pipes cleaning machine

Main specifications for the degreasing facility:

- Pipe geometry:
  - overall diameter and length (baseline: 1.2 m diameter x 15 m length);
  - smooth vs corrugated (spiral vs radial)
- Degreasing rate: ~ 8 pipes/day (360 days/year x 3 year; 120 km / 15 m long pipes)
- Raw material: To be defined (stainless steel / carbon steel)
- Coating: Not defined at this stage

Concept for ET series pipes cleaning machine

Main options for degreasing process machine

Aqueous based process

- Less expensive degreasing facility

- Incompatibility with carbon steel?
- Bigger volumes of waste

Type of contamination?

Integration in the pipe manufacturing process?

Organic solvent based process

- Smaller volumes of waste
- Compatible with all steels

- More expensive degreasing facility

Conclusions

Many options still open

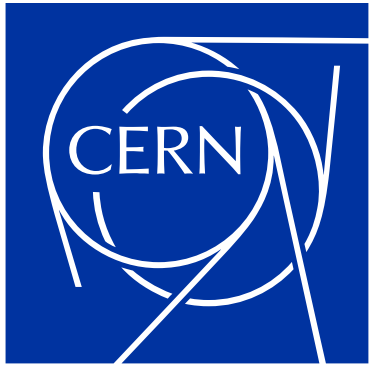
Actively looking for industrial partners for the degreasing of the pilot sector

Actively looking for industrial partners to define the cleaning machine concept and related cost for the production of ET pipes

Thank you for your attention

Questions?

Source: Reuters



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