Cedre

International experts
in spill preparedness and response

imaros

Final conference

Task 4.4 – Shoreline cleanup
Task 4.3 – In Situ Burning

Fanny Chever
CEDRE

Malta, 01/06/2022

Co-funded by
the European Union

Cedre

International experts
in spill preparedness and response

Task 4.4
Shoreline cleanup trials on 3 VLSFO at the pilot scale

Co-funded by
the European Union

imaros

Meso-scale tests

Oil adhesion on the shoreline assessed using the washing robot.

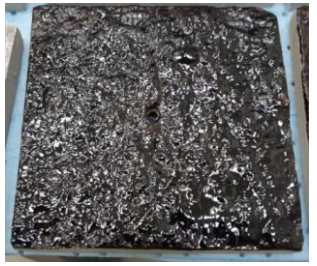
- Ensures consistent washing conditions for all the successive tests (spraying width, speed and distance).
- Ensures hard surfaces (granite tiles) are washed exactly in the same way, and comparative tests can thus be performed.

Task 4.4 : Shoreline cleanup - Protocol

Hard Substrates

- Rocky shoreline simulated by using granite tiles (15 x 15 x 2 cm)

- Surface not smoothed down in order to recreate a substrate as natural as possible
- ~3 g of the tested oils and of the comparative heavy fuel oil are added at the surface of the tiles
- After oiling, tiles are let for drying in a horizontal position for 6 days

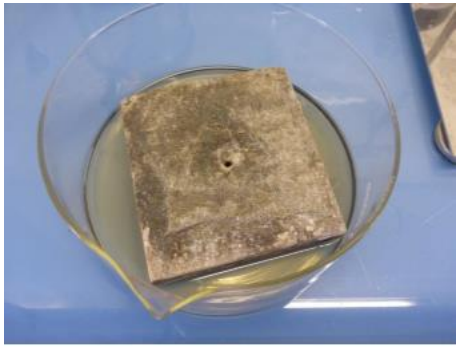


- Tiles then placed in the washing robot for cleaning process
- Different conditions of temperature and pressure studied
  → 4 washing experimental conditions: 15°C/50 bars, 15°C/100 bars, 50°C/50 bars and 50°C/100 bars
- Control tiles : polluted tiles not passed through the washing robot process
- Triplicates are carried out for each condition, total of 15 tiles / oil

Task 4.4 : Shoreline cleanup - Protocol

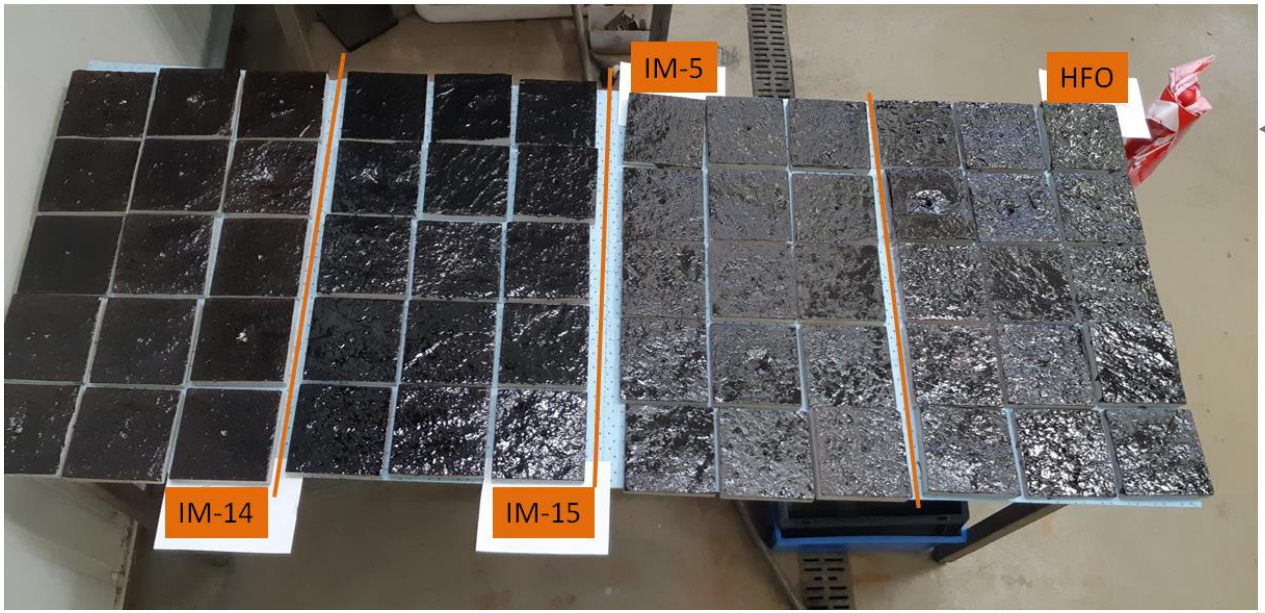
Quantification of oil remaining on tiles after cleaning

- Remaining oil extracted by immerging the tiles in dichloromethane, in an ultrasonic bath for 10 minutes and, after drying on sodium sulphate, diluted to appropriate concentrations
- Absorbance is measured at 580 nm by using a UV/Vis spectrophotometer
- **Cleaning efficiency corresponds to the amount of oil extracted after the washing robot cleaning step divided by the amount of oil extracted from the control tiles**



Task 4.4 : Shoreline cleanup - Results

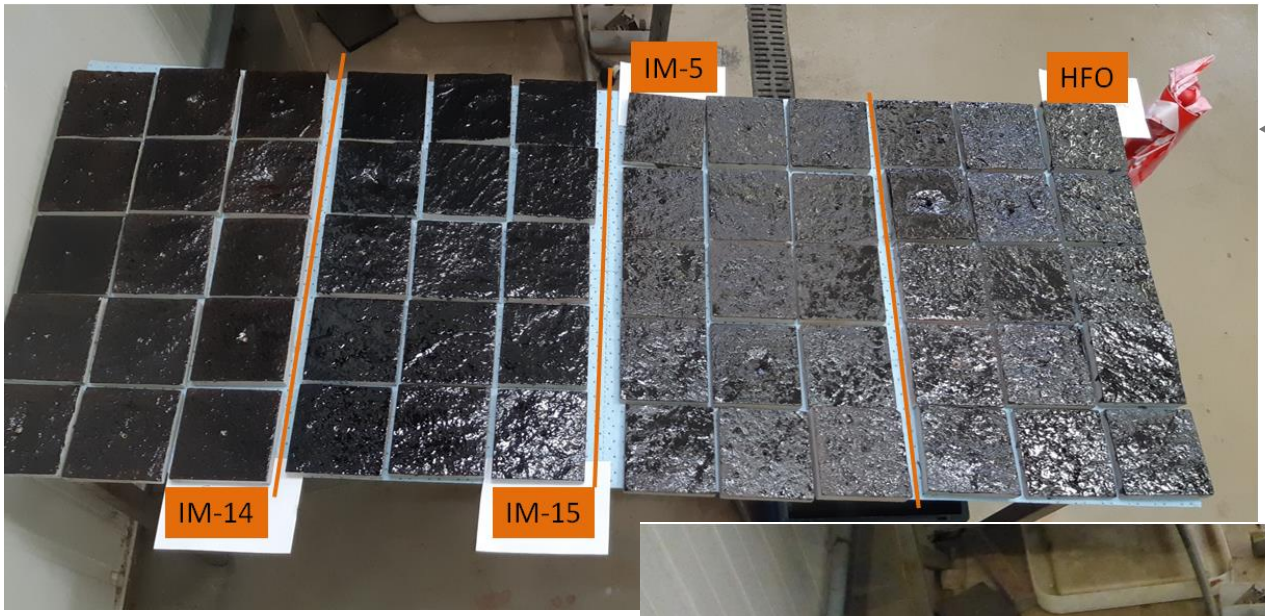
Oil penetration/absorption (no washing)



Immediately after oil spreading

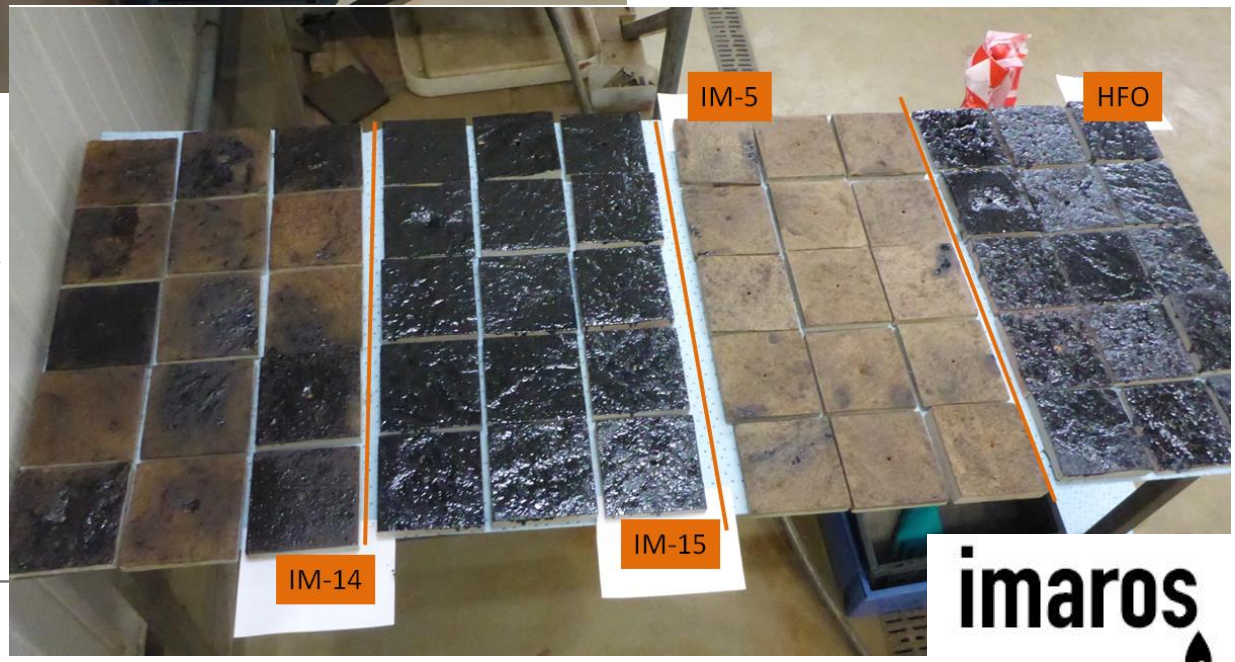
Task 4.4 : Shoreline cleanup - Results

Oil penetration/absorption (no washing)



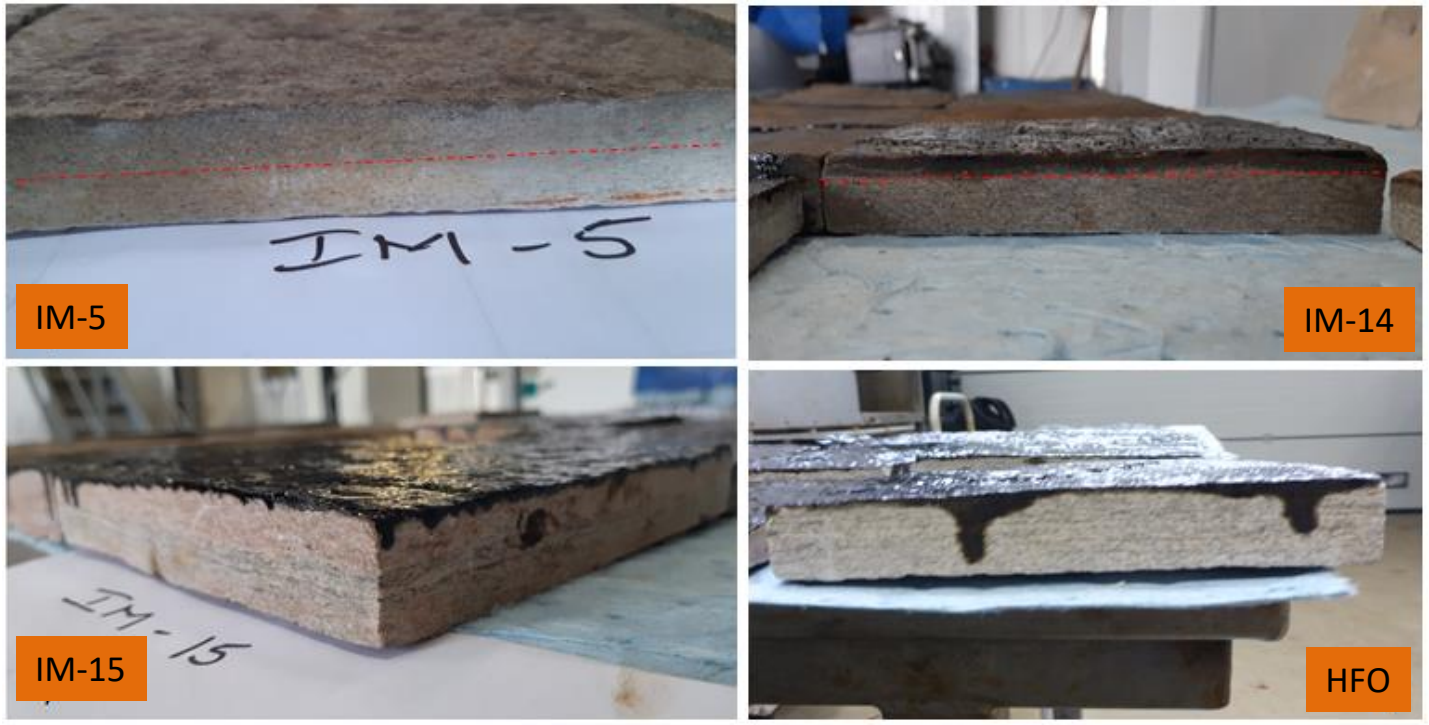
← Immediately after oil spreading

6 days after…. →



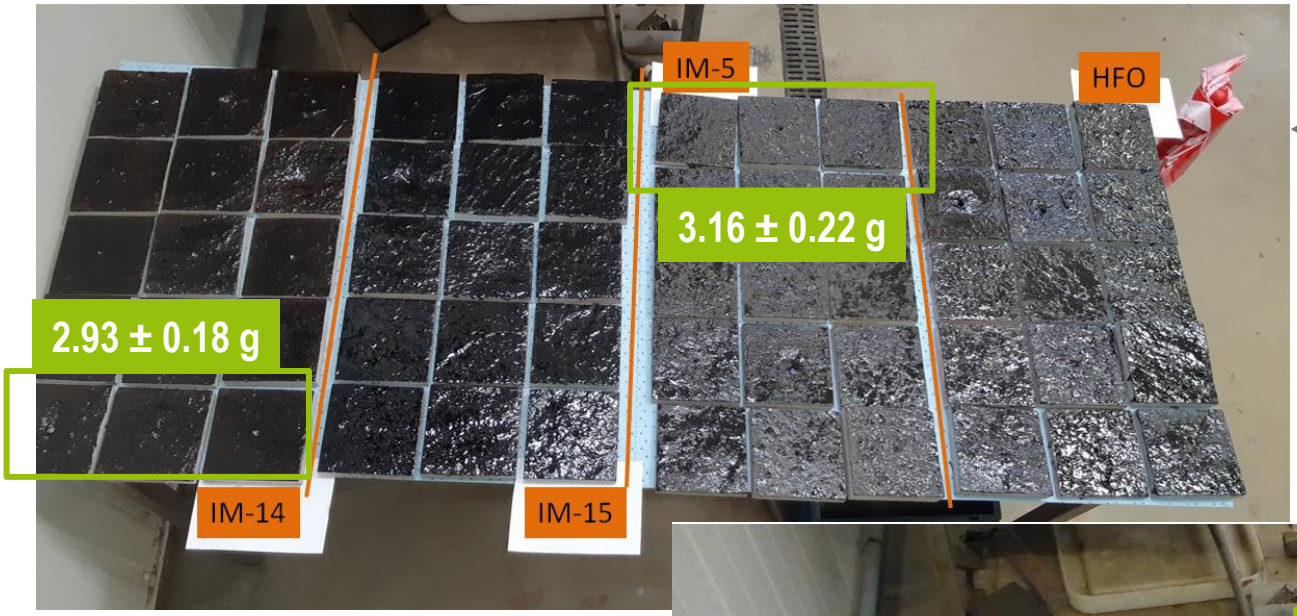
Cedre
Co-funded by the European Union
imaros

Oil penetration/absorption



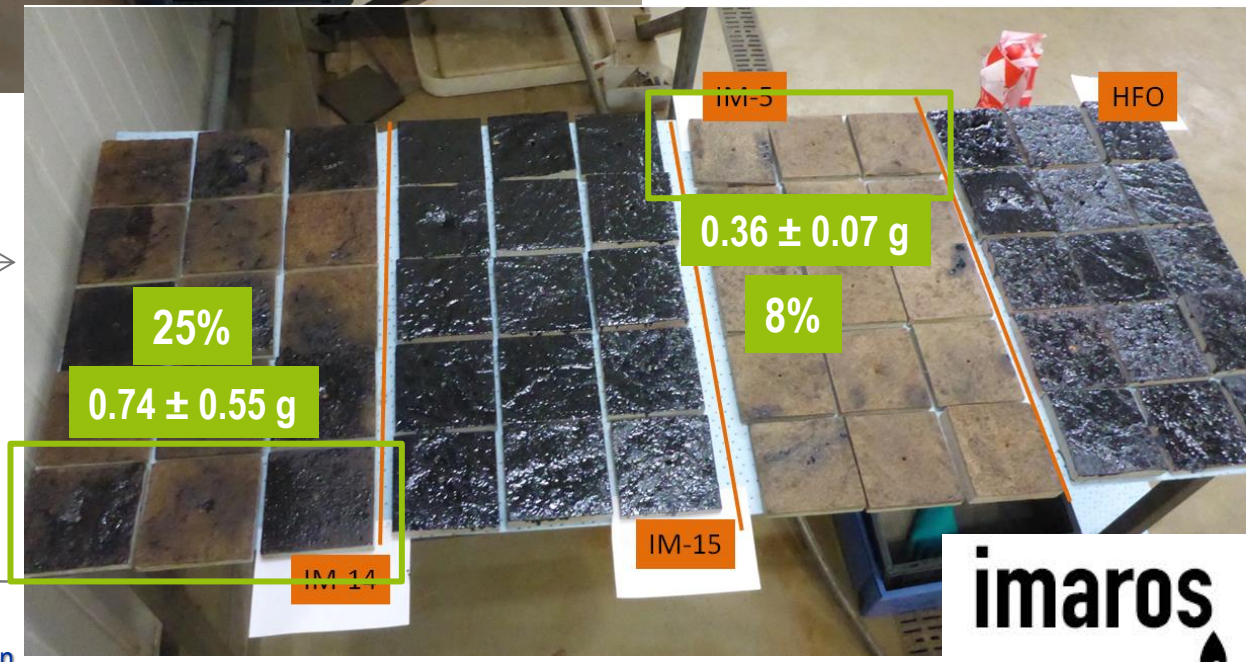
Task 4.4 : Shoreline cleanup - Results

Oil penetration/absorption (no washing)



← Immediately after oil spreading

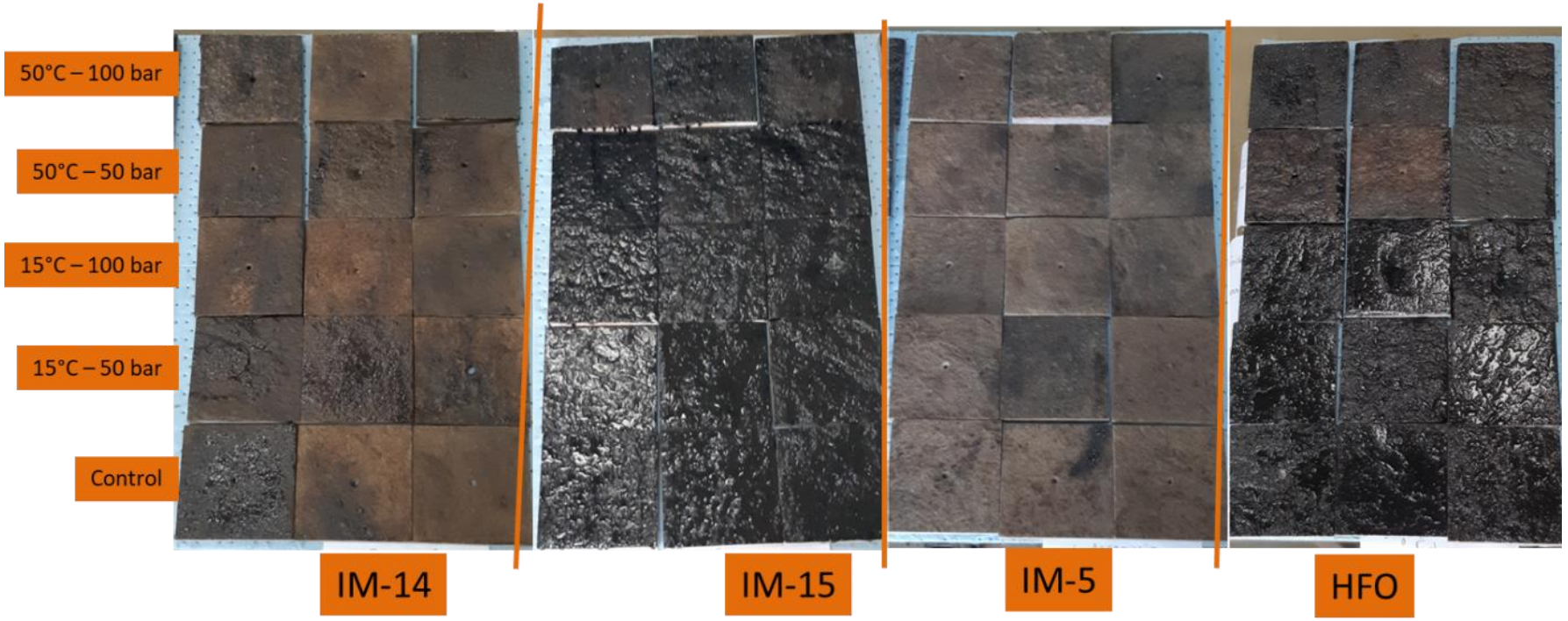
6 days after…. →



Co-funded by the European Union

Task 4.4 : Shoreline cleanup - Results

Washing efficiency

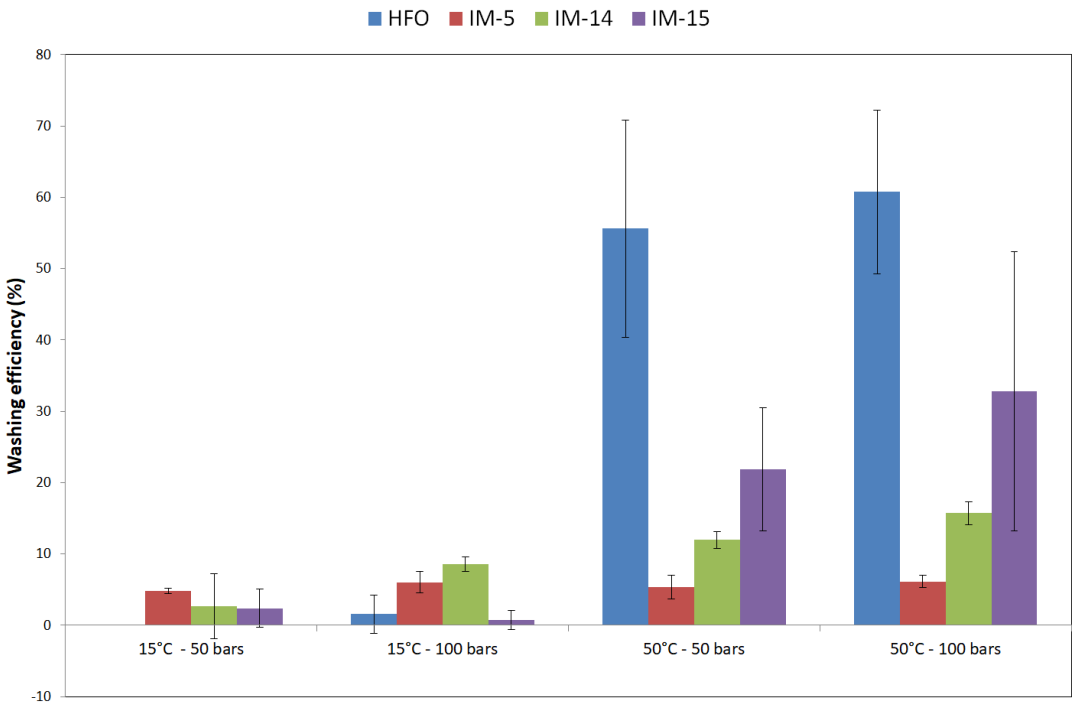


Pictures of the tiles after washing process

Co-funded by
the European Union

Task 4.4 : Shoreline cleanup - Results

Washing efficiency (%)

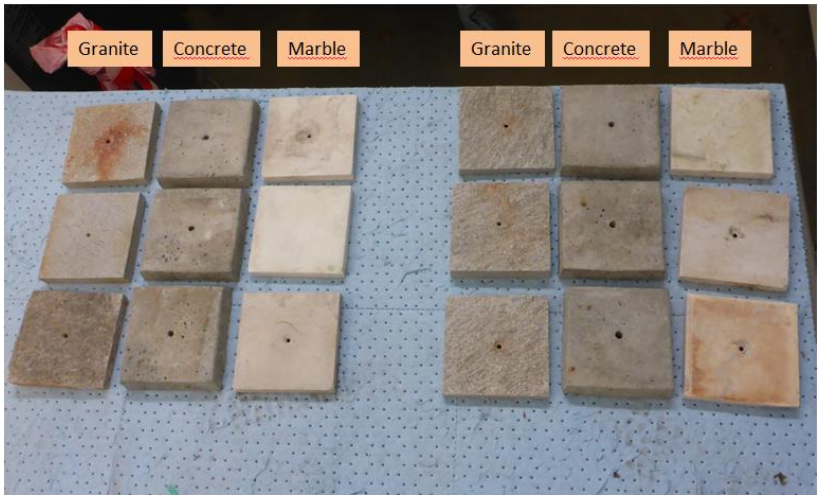


Effect of hot water on efficiency (HFO: 50 – 60 % / IM-15: 20 – 30 %)
IM-5: ~5 %
IM-14: ~15 %

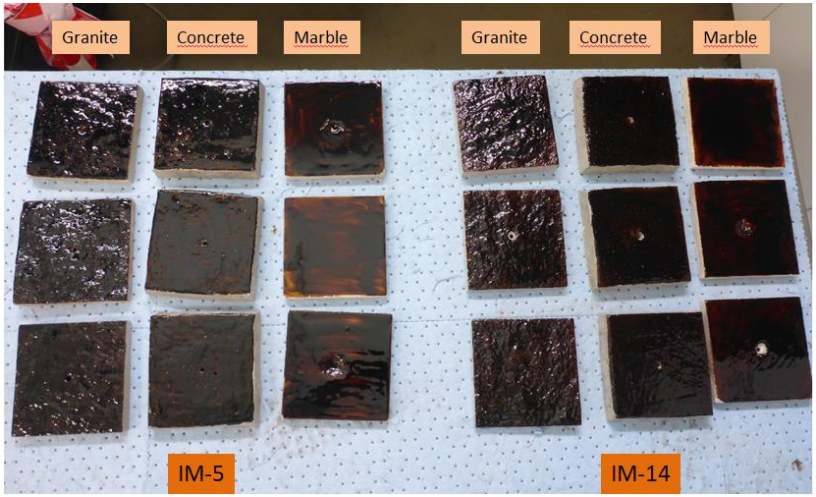
According to this protocol: Washing efficiency seems limited on most of the VLSFO tested

Task 4.4 : Shoreline cleanup - Additional experiments

- IM-5 and IM-14 added on three granite, concrete and marble tiles
- Tiles let for drying 6 days
- Visual observation of the potential penetration performed



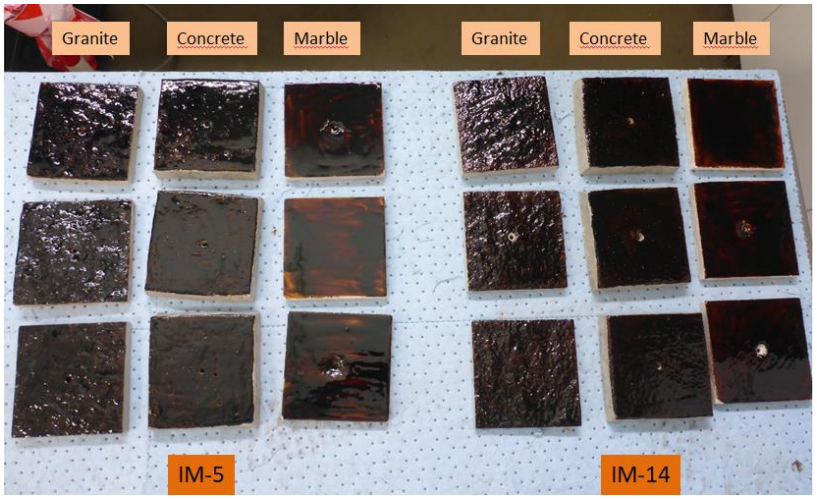
Before oil addition



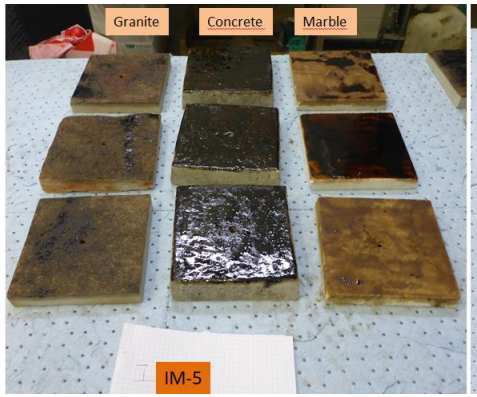
Immediatly after oil addition

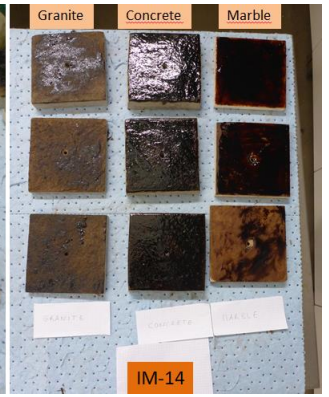
Co-funded by
the European Union

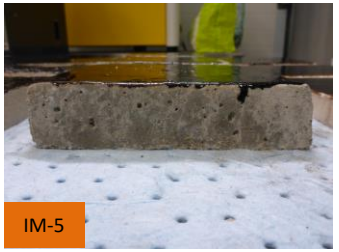
Task 4.4 : Shoreline cleanup - Additional experiments

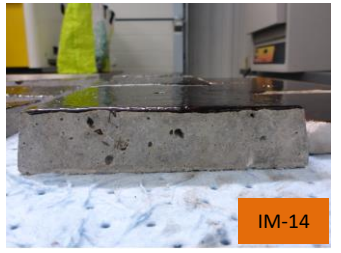


Immediately after oil addition









After drying

- Oil absorption on granite tiles after 6 days drying confirmed
- No absorption visible on the 3 concrete tiles polluted
- Absorption observed for some marble tiles polluted with IM-5 and IM-14

→ **Some rocks may be impacted by this absorption phenomenon**

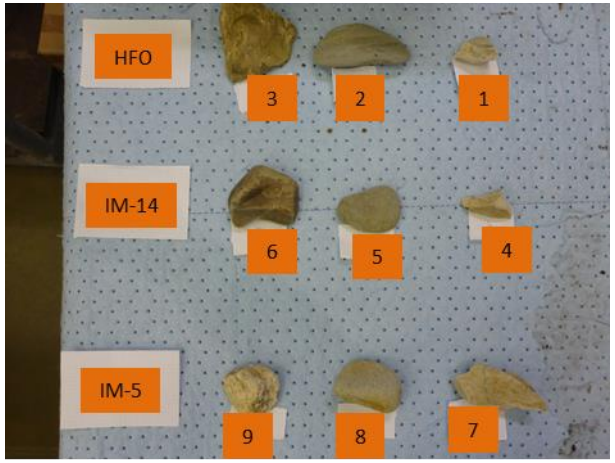
Cedre

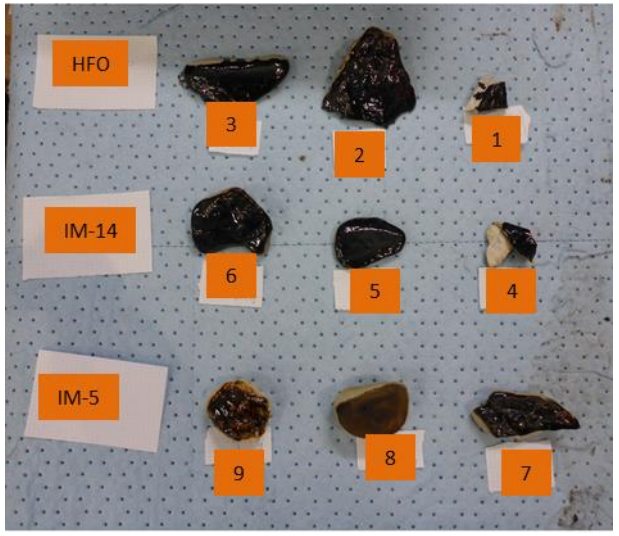
Co-funded by
the European Union

imaros

Task 4.4 : Shoreline cleanup - Additional experiments

- IM-5, IM-14 and HFO added on natural pebbles collected on the shoreline
- Visual observation of a potential penetration performed
- Pebbles broken after several days of contact with the oil (T+3 days, T+7 days and T+14 days) in order to observe the potential presence of absorbed oil

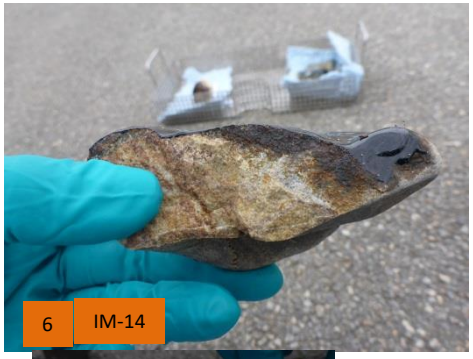


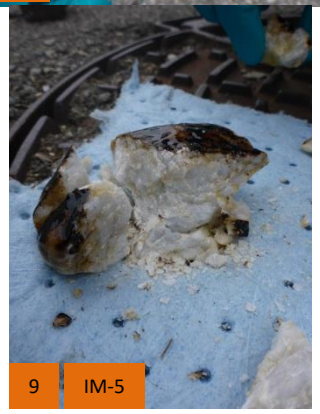


Task 4.4 : Shoreline cleanup - Additional experiments

Pebbles broken after 3 days of contact with the oils

Pebbles broken after 7 days of contact with the oils





Pebbles broken after 14 days of contact with the oils

Co-funded by the European Union

Task 4.4 : Shoreline cleanup - Conclusion

- Following this protocol, washing efficiencies seems limited on LSFO stranded on granite tiles
- Some VLSFO can be absorbed on tiles surface, and to a greater extend to some natural pebbles of different natures
- In case of oil spill at sea, this phenomenon could thus be observed, depending on the VLSFO involved and on the rocks nature
- Additional studies are needed to understand this process

Cedre

International experts
in spill preparedness and response

Burning trials on 3 VLSFO at the laboratory scale
WP4 - Task 4.3

Co-funded by
the European Union

imaros

Task 4.3 : ISB - Burning bench

- According to oil nature:
  - Ignitability of the oil
  - Burning efficiency

- According to burning efficiency: assess the behavior and composition of residue (viscosity, density, PAHs, SARA) and potential water contamination after ISB (PAHs transfer to water column)

Task 4.3 : ISB - Protocol

100 mL oil
Thickness: 10 mm
5L sea water

3 attempts of 10 sec.

Step A

The oil burns

- Burning time recorded
- Determination of burning efficiency (in %)
- Potential characterization of the residue

Task 4.3 : ISB - Protocol

100 mL oil
Thickness: 10 mm
5L sea water

3 attempts of 10 sec.

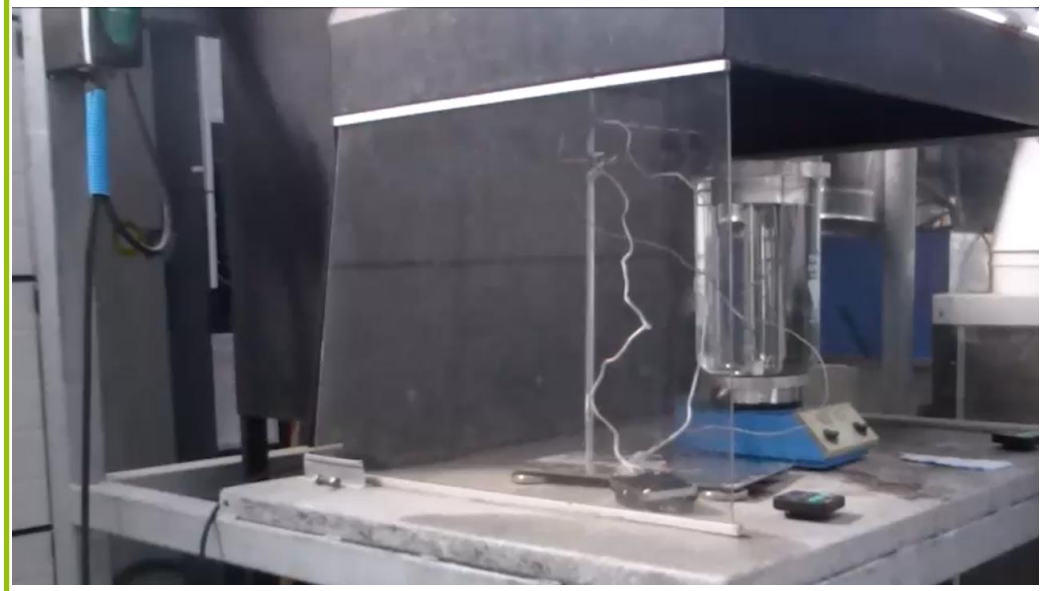
Step A

1) Continous flame (max. 10 min.)

Step B

The oil does not burn

Task 4.3 : ISB - Protocol



1) Continous flame (max. 10 min.)

Step B

The oil does not burn

Task 4.3 : ISB - Protocol

100 mL oil
Thickness: 10 mm
5L sea water

3 attempts of 10 sec.

Step A

1) Continous flame (max. 10 min.)

Step B

The oil does not burn

2) Igniter addition **Step C**

Task 4.3 : ISB - Results and conclusion

	IM-5	IM-15	IM-14	HFO
Step A (trials 1, 2 and 3) (burning time)		10 min		
Step B (burning time)	~10 min	9 min		
Step C (burning time)	-	-	6 and 12 min	3 min
Burning efficiency (%)	**16**	**10**	**10**	**3**

- Low ignitability of the 3 VLSFO tested
- Low burning efficiency

Based on the 3 VLSFO tested in this study, In Situ Burning seems difficult to be applied in real conditions
Larger scale tests could lead to more optimistic conditions

imaros

Final conference

Task 4.4 – Shoreline cleanup
Task 4.3 – In Situ Burning

Fanny Chever
CEDRE

Malta, 01/06/2022

Co-funded by
the European Union