



## USE OF SORBENTS FOR RECOVERY

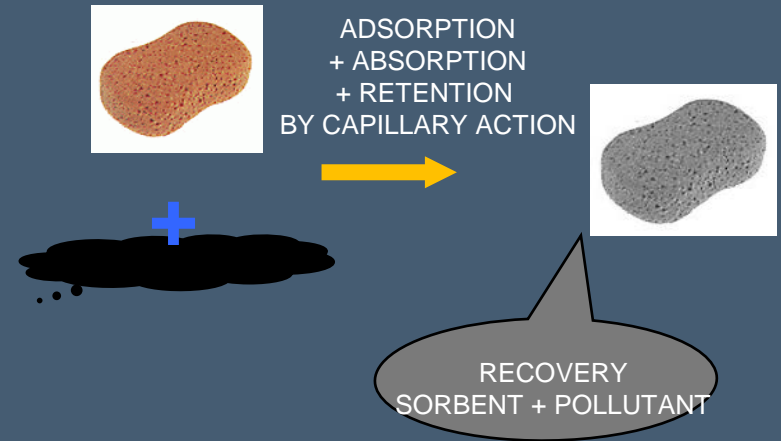
20<sup>th</sup> Cedre Information Day

S. Le Floch and P. Le Guerroué

# SORBENTS

- Conventional method

- How they work
- Complementary technique to dispersants and recovery



- Universal sorbents

- Sorption of all liquids (hydrophilic and oleophilic)
- Use on land
- Industrial contexts

- Floating hydrophobic sorbents

- Sorption of oleophilic substances (~~hydrophilic~~, water soluble)
- Use on water and on land

# SORBENTS

- Types of sorbent
  - Various compositions
    - Plant origin (Peat...)
    - Mineral origin (Glass wool...)
    - Synthetic (Polypropylene...)
  - Different forms

A: Loose



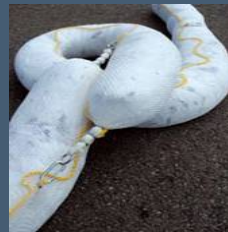
B: Pads



C: Rolls



D: Pillows



E: Booms  
- Socks



F: Mops  
- Pom poms



G: Others

# HISTORIC OF SORBENT USE

- Originally
  - In the open sea (trials)
  - Large quantities of sorbent used
  - Used loose
- Today, preferably
  - In contained, accessible areas
  - Recovery of small quantities (maximum 1 m<sup>3</sup>)
  - Use of small quantities of sorbent, preferably in conditioned forms (pads, booms, mops...)



# EXAMPLE OF USE

The objective is:

- To restrict spreading/ contain/ protect
- To recover the pollutant
- To help in finishing cleanup operation



# SORBENT TESTING (approval)

- Standardised protocols - laboratory scale (Cedre)
  - NFT 90-360 → Floating hydrophobic sorbents
    - Hydrophobicity, oil retention
    - Loose, pads, boom materials
  - NFT 90-361 → Universal sorbents
    - Water and oil retention
    - Loose, pads



# SORBENT TESTING (approval)

- Selection criteria



	Loose (type A)	Pads, rolls, mats... (types B & C)	Booms, pillows,... alternative materials (types D, E, F & G)
<b>Sorption capacity</b>			
<b>Cr sat (weight)</b>	<b>&gt; 5</b>	<b>&gt; 5</b>	<b>&gt; 10</b>
	<b>or</b>		
<b>Cr sat (volume)</b>	<b>&gt; 0.5</b>		
<b>Hydrophobic capacity</b>	<b>&lt; 0.25</b>	<b>&lt; 0.25</b>	<b>&lt; 0.25</b>
<b>Cr water/Cr sat (weight)</b>			
<b>Stability</b>	<b>stable and non-friable</b>	<b>resistant</b>	<b>stable and non-friable</b>

- List of approved sorbents

- floating hydrophobic sorbents
- universal sorbents

CARACTERISTIQUES DE PRODUITS ABSORBANTS FLOTTANTS POUR HYDROCARBURES UTILISABLES EN MER OU SUR PLAN D'EAU INTERIEUR ( NORME NFT90-360)

**PRODUITS ABSORBANTS de TYPE A (vrac)**

Nom du produit	Nature du matériau	Aspect	Pouvoir absorbant en poids	Fournisseur
ABSORLENE N	fibre de verre	fibreux jaune	28,6	ISOVER
ABSORBPAL vrac	mousse phénolique	floconneux mauve	64,1	RIVARD
ADSORPOL	polypropylène additionné de carbone	palettes blanches et noires	7,0	GTI sa
BLACK GREEN	mousse phénolique	floconneux rose	72,0	Groupe CAL-X
CANSORB	végétale (tourbe)	fibreux brun	7,9	ACANTHE Sarl
DIPSORBT	polymère d'uréthane	granulats	19,0	SAITEC SA
ELCOSORB	végétale (tourbe)	fibreux brun	7,8	DIPTER
ERGON	polypropylène	spaghettis blancs	10,6	ERGON SORBENT / GEMADIS
FIBERPERL	perlite et cellulose	fibreux brun	6,2	TEES
MEPOXAB	poudre d'époxy	poudre blanche	19,0	M.S.M.
MICROSORB	polypropylène	flocons blancs	13,7	SCHOELLER & HOESCH
REPSORB SPAGHETTI	polypropylène	fibreux blanc	9,0	REP
SPC 27	polypropylène	fibreux blanc	11,0	SICSA
VERDYOL SORBENT	végétale	fibreux crème	12,5	VERDYOL INTERNATIONAL

Exemple de liste d'absorbants

# SORBENT TESTING (Efficiency)

- Hydrophobicity, oil retention, compaction test
- Full boom
- Skirted boom



## EDITING TECHNICAL DOCUMENTATION

- Sorbents guide
  - Republished in 2009





# CURRENT CONCERNS (new products)

Sorbent	Material	Origin	Tested by Cedre
Corksorb	Cork	Portugal	yes
GO-1	Mineral wool	Israel	yes
Deurex	Polyethylene	Germany	yes
Avisorb	Recycled chicken feathers	USA	yes
Opflex	Polyolefin foam	USA	no

# Cases of accident

# DEEPWATER HORIZON

- Quantity used:
  - Over 760 km of floating boom
  - Over 2600 km of sorbent boom
  
- Shoreline protection
  - Simple protection:  
boom + mooring stakes
  - Double protection (common practice in the US)
    - Floating boom and sorbent boom



# HEBEI SPIRIT

- High degree of involvement of volunteers, local residents and fishermen
  - Up to 10,000 local residents/fishermen per day
  - Sometimes over 50,000 volunteers per day
- Manual recovery
  - Manual cleaning of pebbles
  - Beach clean-up



# ALTERNATIVES TECHNIQUES

- Overwintering film
    - Effluents with low water and pollutant content
  - Eel nets
    - Irregular deposits
  - Geotextile (polyethylene)
    - Protection
  - Makeshift sorbents
    - Loose natural sorbent in makeshift envelope
  - Sorbents / biodegradation
    - Natural sorbent (hay, rice hull, cotton fibre...)
    - Inaccessible, fragile areas (marshland...)
    - Restrict spread
- No recovery possibly: biodegradation of sorbent - pollutant



# USE OF SORBENT IN HNS SPILL RESPONSE

# SORBENTS IN RESPONSE TO HNS

- Opportunities
  - Present in stockpiles
  - Perform well on oil
  - Easy to use
- Chemicals of interest ?
  - Commonly transported HNS and listed pollutants (past spills)
  - Floaters, Evaporator... HNS (SEBC classification: F<sub>(p)</sub> E...)



Current study

USE OF SORBENT IN HNS SPILL RESPONSE



# SORBENTS IN RESPONSE TO HNS

- Floating sorbents of interest
  - Various materials  
(peat, cork, polypropylene, polyester, HDPE...)
  - Various forms
    - LOOSE (flakes, granules, fibres...)
    - Pads (non-reinforced, reinforced + coverstock...)
    - Mops
- 30 sorbents listed



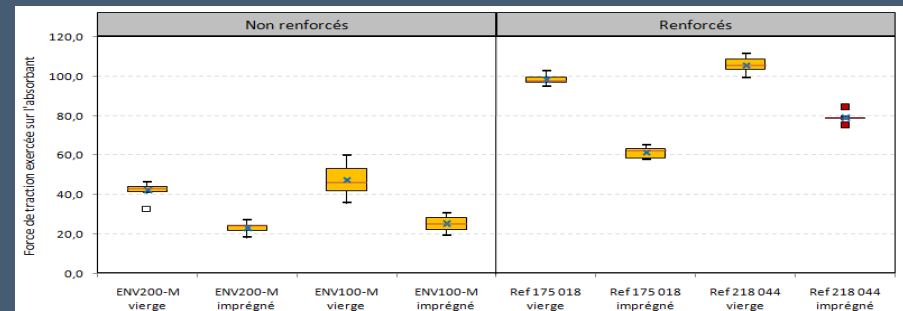
Pads				
Sorbent name	Appearance	Type of material	Thickness	Specificities
ENV 100-M		Polypropylene	Two-ply	Non-reinforced
ENV 200-M		Polypropylene	One-ply	Non-reinforced
Ref 175,018		Polypropylene	One-ply	Reinforced
Ref 218,044		Polypropylene	Two-ply	Reinforced + coverstock



# TO DEFINE ADAPTED PROTOCOLS

## Performance tests

- Chemical resistance
  - Compatibility
- Tensile strength
  - Towing trial
  - Reinforced sorbents are twice as strong

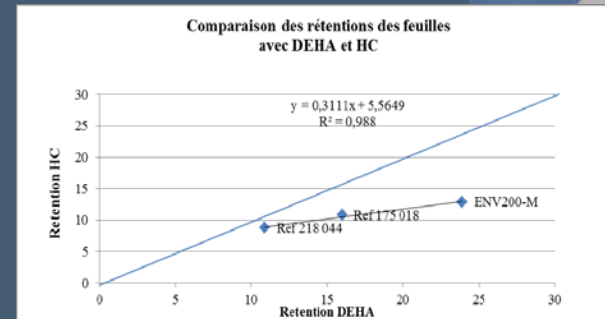
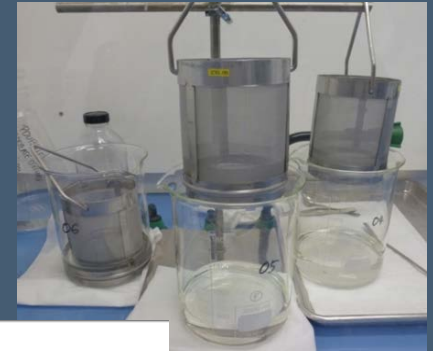


# TO DEFINE ADAPTED PROTOCOLS

## Performance tests

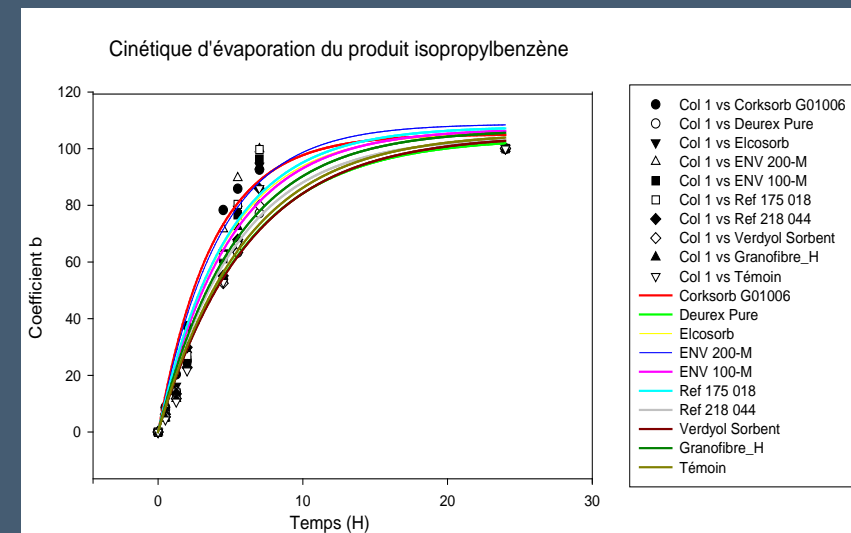
- Retention

- Quantity absorbed
- Correlation between HNS and oil retention



- Reduction in evaporation

- Comparison of evaporation with and without sorbent



# PRELIMINARY RESULTS

PRODUITS	PARTICULARITE (texture, nature chimique...)	CYCLO HEXANONE		ISOPROPYL BENZENE		N-OCTANE		STYRENE		XYLENE		1-OCTANOL		ACIDE SULFURIQUE		
		Comp	Evap	Comp	Evap	Comp	Evap	Comp	Evap	Comp	Evap	Comp	Evap	Comp	Evap	
VRAC	CORKSORB G01006	liège		+		+		+		+		-		0		np
	DEUREX PURE	Polyéthylène		+		-		+		+		-		0		np
	DIPSORB S	Polyuréthane		nr		nr		nr		nr		nr		nr		np
	ELCOSORB	Tourbe		-		+		+		+		+		0		np
	GRANOFIBRE H	Bois		-		+		+		+		+		0		np
	VERDYOL SORBENT	Végétale		-		-		-		-		-		0		np
FEUILLE	ENV 100-M	Double épaisseur non renforcé		-		+		+		+		+		0		nr
	ENV 200-M	Simple épaisseur non renforcé		-		+		+		+		+		0		nr
	REF 175018	Simple épaisseur renforcé		+		+		+		+		+		0		nr
	REF 218 044	Double épaisseur renforcé + voile de renfort		-		+		-		+		-		0		nr
AUTRE	ECHEVEAUX	Polyéthylène Haute Densité (PEHD)		nr		nr		nr		nr		nr		nr		nr

np: not relevant

nr: not done

## Légende

Compatibilité	Compatibilité des absorbants vis-à-vis des produits chimiques et en fonction de la durée d'imprégnation	1h	BONNE COMPATIBILITE
		7j	
		1h	COMPATIBILITE PASSABLE
		7j	
1h	INCOMPATIBILITE		
7j			
Evaporation	Suivi de la cinétique d'évaporation des produits chimiques recouverts d'absorbant.	+	ACCELERATION DE L'EVAPORATION
		0	SANS EVAPORATION
		-	ATTENUATION DE L'EVAPORATION

# PRELIMINARY RESULTS

PRODUITS	PARTICULARITE (texture, nature chimique...)	BIS(2ETHYLHEXYL) ADIPATE (ou DEHA)				
		Compatibilité	Rétention	Résistance	Evaporation	
VRAC	CORKSORB G01006	liège		10	np	0
	DEUREX PURE	Polyéthylène		11	np	0
	DIPSORB S	Polyuréthane		20	np	0
	ELCOSORB	Tourbe		9	np	0
	GRANOFIBRE H	Bois		7	np	0
	VERDYOL SORBENT	Végétale		11	np	0
FEUILLE	ENV 100-M	Double épaisseur non renforcé		18	60	0
					31	
	ENV 200-M	Simple épaisseur non renforcé		24	46	0
					27	
	REF 175018	Simple épaisseur renforcé		16	103	0
					65	
REF 218 044	Double épaisseur renforcé + voile de renfort		11	112	0	
				84		
AUTRE	ECHAVEAUX	Polyéthylène Haute Densité (PEHD)		np	np	nr

## Légende

Compatibilité	Compatibilité des absorbants vis-à-vis des produits chimiques et en fonction de la durée d'imprégnation	1h 7j	BONNE COMPATIBILITE
		1h 7j	COMPATIBILITE PASSABLE
		1h 7j	INCOMPATIBILITE
Rétention	Détermination de la capacité d'absorption (g Produit Chimique / g Absorbant)		
Résistance	Mesure de résistance à la traction (en Newton) ; que pour les absorbants conditionnés en feuille		FEUILLE NON IMPREGNEE
			FEUILLE IMPREGNEE
Evaporation	Suivi de la cinétique d'évaporation des produits chimiques recouverts d'absorbant.	+	ACCELERATION DE L'EVAPORATION
		0	SANS EVAPORATION
		-	ATTENUATION DE L'EVAPORATION

# SORBENTS IN RESPONSE TO HNS

- Further investigation in 2015
  - Compatibility
    - A dozen additional products
  - Retention
    - Correlation between oil and chemical retention
  - Tensile strength
    - 2 new chemicals
  - Evaporation
    - Optimise the protocol with regard to a spill scenario

# CONCLUSION

- Large range of sorbents
- Widely use in oil spill response (too much?)
- « Diversion » of material into sorbent
  
- Potential established in HNS response
- But performance needs to be evaluated by appropriated tests

THANK YOU FOR YOUR ATTENTION

