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Industry Progress in Reducing Refinery Discharge

9th CONCAWE Symposium

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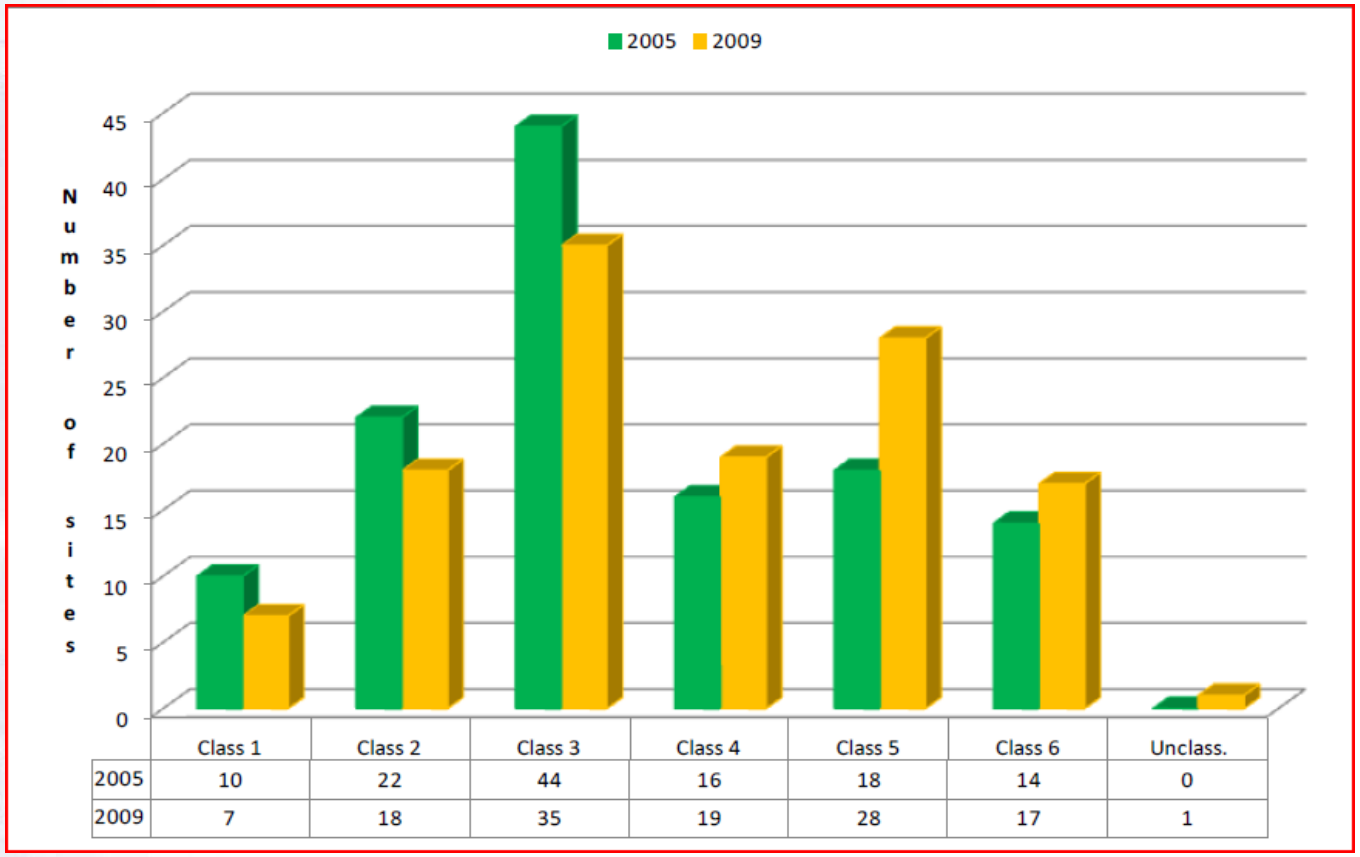
INTRODUCTION

- CONCAWE regularly reports oil emissions in the effluents. What are we learning from this?
- What are the changes in the refining processes and eventually in the effluents ?
- Did the industry make improvements in the treatments of their effluents ?
- What is the trend of oil emissions at European level ?
- How does it compare to the refinery BREF ranges?
- Why CONCAWE has a major role to play in BREF discussions?

Refinery process evolution

- Refinery complexity increases (constantly since 1969)



	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6	Unclass.
2005	10	22	44	16	18	14	0
2009	7	18	35	19	28	17	1

More cracking, desulfurisation capacity … → more COD, more phenols,…
and also more water use (i.e. Process water, Cooling water…)

Wastewater treatment evolution

Table 3 Wastewater treatment systems in oil refineries – pre-2005 data

Year of survey	Number of refineries reporting these data	Refineries equipped with:									
		Gravity separation only (G)		G plus advanced treatment only (GA)		GA plus biological treatment (GAB)		GAB plus final polishing		G or GA plus offsite biological treatment	
		No.	%	No.	%	No.	%	No.	%	No.	%
1969	82	51	62	12	15	19	23	n.a.	n.a.	n.a.	n.a.
1974	112	47	42	21	19	44	39	n.a.	n.a.	n.a.	n.a.
1978	109	40	37	15	14	54	49	n.a.	n.a.	n.a.	n.a.
1981	105	31	30	19	18	55	52	n.a.	n.a.	n.a.	n.a.
1984	85	15	18	8	9	62	73	n.a.	n.a.	n.a.	n.a.
1987	89	13	15	10	11	66	74	n.a.	n.a.	n.a.	n.a.
1990	95	7	7	12	13	76	80	n.a.	n.a.	n.a.	n.a.
1993	95	6	6	8	8	81	85	n.a.	n.a.	n.a.	n.a.
1997	105	6	6	8	8	92	88	n.a.	n.a.	5	5
2000	84	3	4	4	5	55	65	14	17	8	10

Since 1969 the percentage of refineries equipped with a biological step continuously increased.

Today's refinery wastewater treatment

Table 4 Wastewater treatment systems in oil refineries – 2005 data

Year of survey	Number of reported discharge points	Refinery effluent discharges and their final treatment system:											
		G		GA		GB		GAB		GABP		External WWTP	
		No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
2005	113	3	3	10	9	25	23	65	59	5	5	13	12

In 2005, 88% of the refineries had a biological treatment in place

Table 5 Final effluent treatment as reported for 2008 discharges.

Treatment		Type of biological treatment	
3 Stage biological	103	Activated sludge	78
Mechanical	2	Trickling filter	16
Chemical	2	Aerated lagoon	5
Physical	4	Non aerated lagoon	1
API	0	Fixed-bed bio-film reactor	1
External WWTP	14	Aerated tank	1
none	0	Other not specified	1
		External not specified	14
Total	125	Total	117

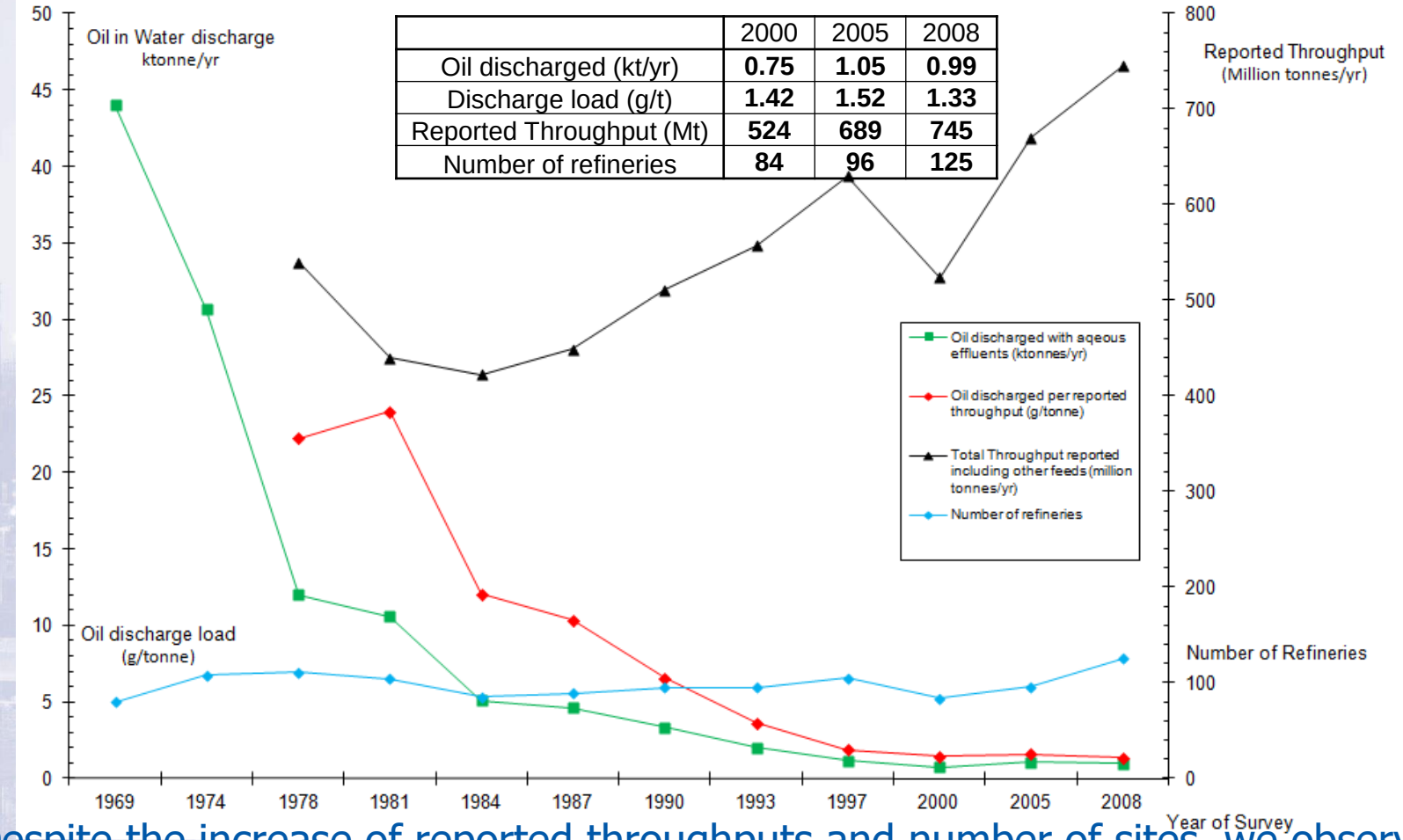
In 2008, only 6% of the refineries were not equipped with a biological treatment!

Wastewater of 94% of the refineries is treated applying technologies described into the sectorial BREF (3 step biological treatment)

concawe Trends in oil discharged with aqueous effluent

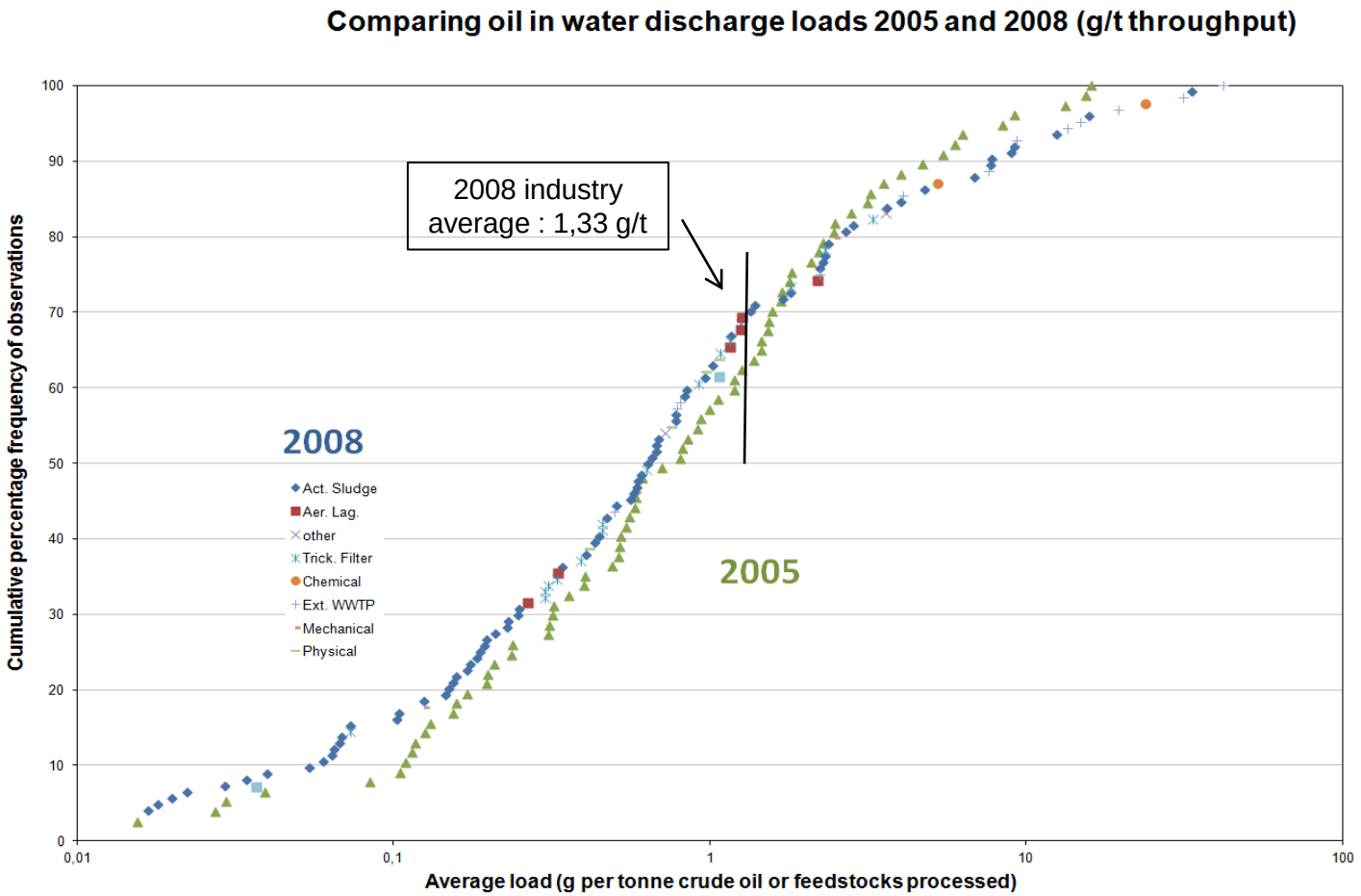
- Data gathered since 1969 on oil in water

	2000	2005	2008
Oil discharged (kt/yr)	**0.75**	**1.05**	**0.99**
Discharge load (g/t)	**1.42**	**1.52**	**1.33**
Reported Throughput (Mt)	**524**	**689**	**745**
Number of refineries	**84**	**96**	**125**



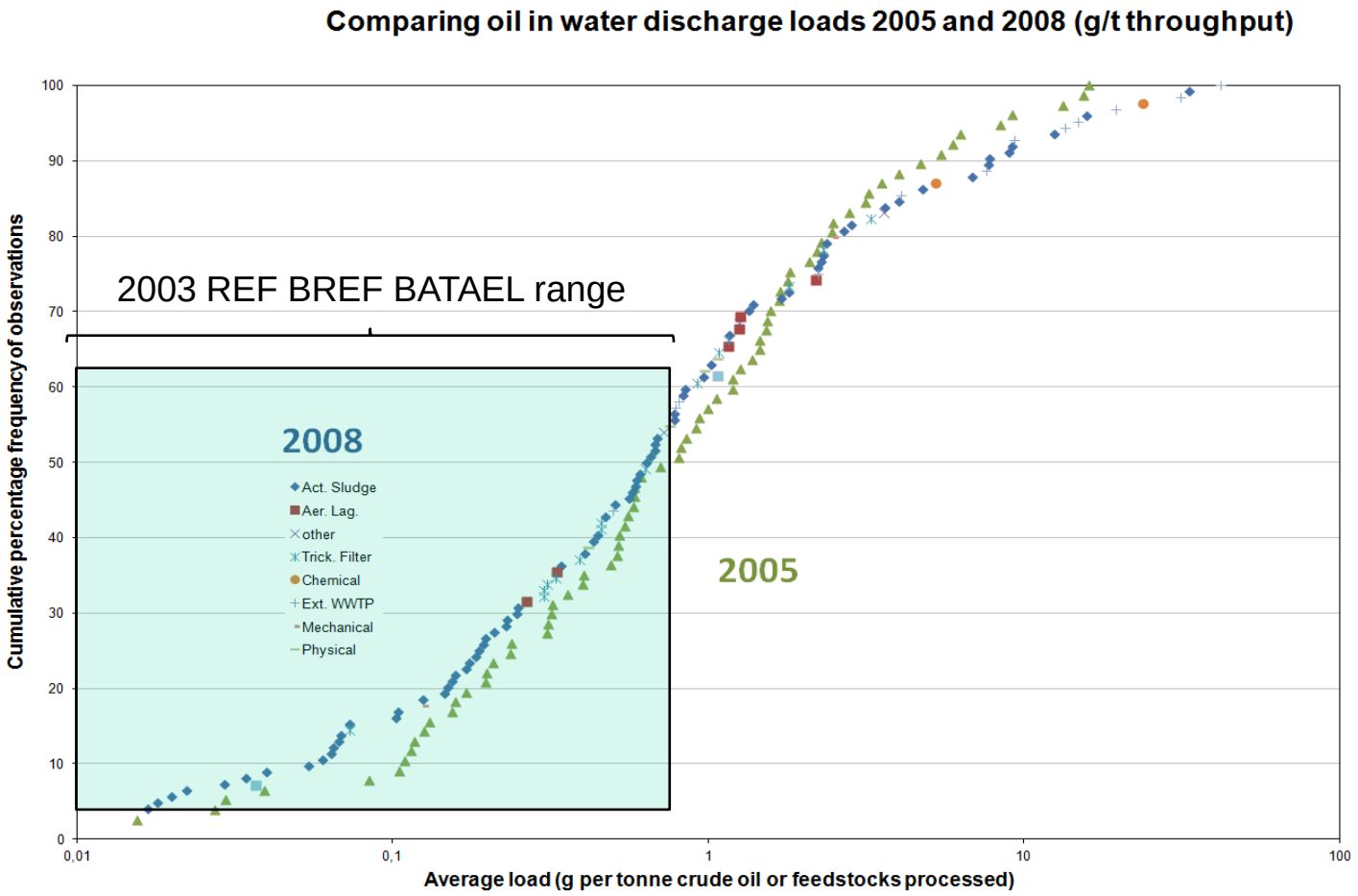
Despite the increase of reported throughputs and number of sites, we observe a continuous decrease in the quantity of oil discharged per ton of throughput

Reported loads (g/t) of 2005 and 2008



- A slight improvement in efficiency
- Higher values for the last 20% (complexity↗ , new reporting sites?, different level of pressure in European countries)

Industrial Emissions Directive potential impact



- In 2008 only 55% comply with the BATAEL range of the current BREF!
- How are HC measured in different countries?

How to compare pears and apples?

- Different analytical methods used
  - In 2005 and 2009 surveys TPH is measured with 29 different methods
  - Time averaging variability:
    - Daily
    - Monthly
    - Yearly
  - How to report LoD?
    - QA/QC Directive
  - How to report LoQ
    - LoQ/2?

Methods described in National or International Standards	Number of Refineries	Countries where used	LOD (mg/l)
ISO 9377	10	F, D, NL, N, Hun	0.1 - 1
NF T 90-203	8	F	0.1 - 0.5
APHA 5520	6	GR, ES, P	0.1 - 0.2
IP 426	3	UK	0.5 - 1
IRSA 5140	2	It	0.0005
IRSA 5160	2	It	0.01 - 0.05
DEV H18	2	D	0.05 - 0.5
BBMS 036	1	F	Not reported
NFT 90-114	1	F	0.1
EA Blue Book 117517283A	1	UK	0.2
HMSO 1983	1	UK	0.1
UK 1412	1	UK	0.1
SCA 1983	1	UK	Not reported
ROG-2110	1	D	0.5
Waste water regulation	1	D	Not reported
SCR 1102	1	S	Not reported
SPI - SCR	1	S	0.2
SS 02 81 45-4	1	S	0.4
DS/R 209 modified	1	DK	0.1
PN-C-04565-01:1982	1	Pol	0.1
EPA METHOD 418 .1	1	GR	Not reported
Li National method	1	Lit	0.05
Other method descriptions			
IR	4	F, ES, CH	0.1
FT-ir spectroscopy	1	UK	Not reported
GC	1	N	0.1
Optical absorbance (3.4-3.5nm)	1	GR	Not reported
KW Index (HC Index)	1	D	Not reported
Total hydrocarbon analysis	1	CH	0.02
Methods not described	3	SU, NL, ES, D, It	0.0005 - 2
LOD Overall range (if known)			0.0005 - 2

- High level of uncertainty in the benchmark exercise : must be considered in BREF discussions *(CONCAWE report 10/02)*

Issues within the BREF revision/discussions

Parameters	Current BREF				BREF D1 table 4.116			
	CONCENTRATION		LOADS		CONCENTRATION		LOADS	
	mg/l monthly average		g/tonne annual average		mg/l annual average		g/tonne annual average	
	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper
Total hydrocarbon content	0,05	~~1,5~~ 3	0,01	0,75	< 0.1	1	< 0.1	0,5
Biochemical oxygen demand (5 day ATU @ 20 °C)	2	20	0,5	11	2	10	0,5	3
Chemical oxygen demand (2 hour)	30	125	3	70	< 30	60	<10	25
Ammoniacal nitrogen (as N)	0,25	10	0,1	6	0,25	2,5	0,1	1
Total nitrogen	1,5	25	0,5	15	2	10	0,5	3
Suspended solids (dried @ 105 °C)	2	50	1	25	< 5	15	1	5
Total metals (As, Cd, Co, Cr, Cu, Hg, Ni, Pb, V, Zn)	< 0.1	4						
TOC					5	15	1	5

CONCAWE Proposed BAT ranges			
CONCENTRATION		LOADS	
g/l annual average		g/tonne annual average	
lower	upper	lower	upper
0,25	3	0,15	2
2	20	2	20
20	100	15	70
0,5	10	0,2	6
4	25	2,5	15
5	25	2,5	25
0,1	4	n.a.	n.a.
1	20	0,5	10

- BREF rapporteur and some MS want lower values (statistical approach instead of technical/environmental consideration)
- Figures proposed in the current draft are not realistic towards performances of BAT as shown earlier (BE and ES agree!)
- CONCAWE has to defend BATAELs : achievable (technique based) and representative (yearly average and interdependent)

CONCLUSION

- CONCAWE trend reports demonstrate that since 1969, the oil discharges of refining industry has decreased continuously.
- This is achieved despite more and more complex refining schemes
- Improvements in treatment techniques (technology and operation) explain the observed trend for the whole refining sector
- Further improvements can still be expected for a minority of sites. Industrial Emissions Directive forces into that direction.
- Industry involvement in BREF revisions is crucial as the coming permit revisions will have to comply with BAT conclusions which are derived from this document.

CONCAWE members' support will be appreciated (questionnaires, doc comments/review)