Laboratory investigations on fume emissions generated by bituminous mixtures

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SEVENTH FRAMEWORK PROGRAMME

Emissions from the field

Combustion emissions

Field studies

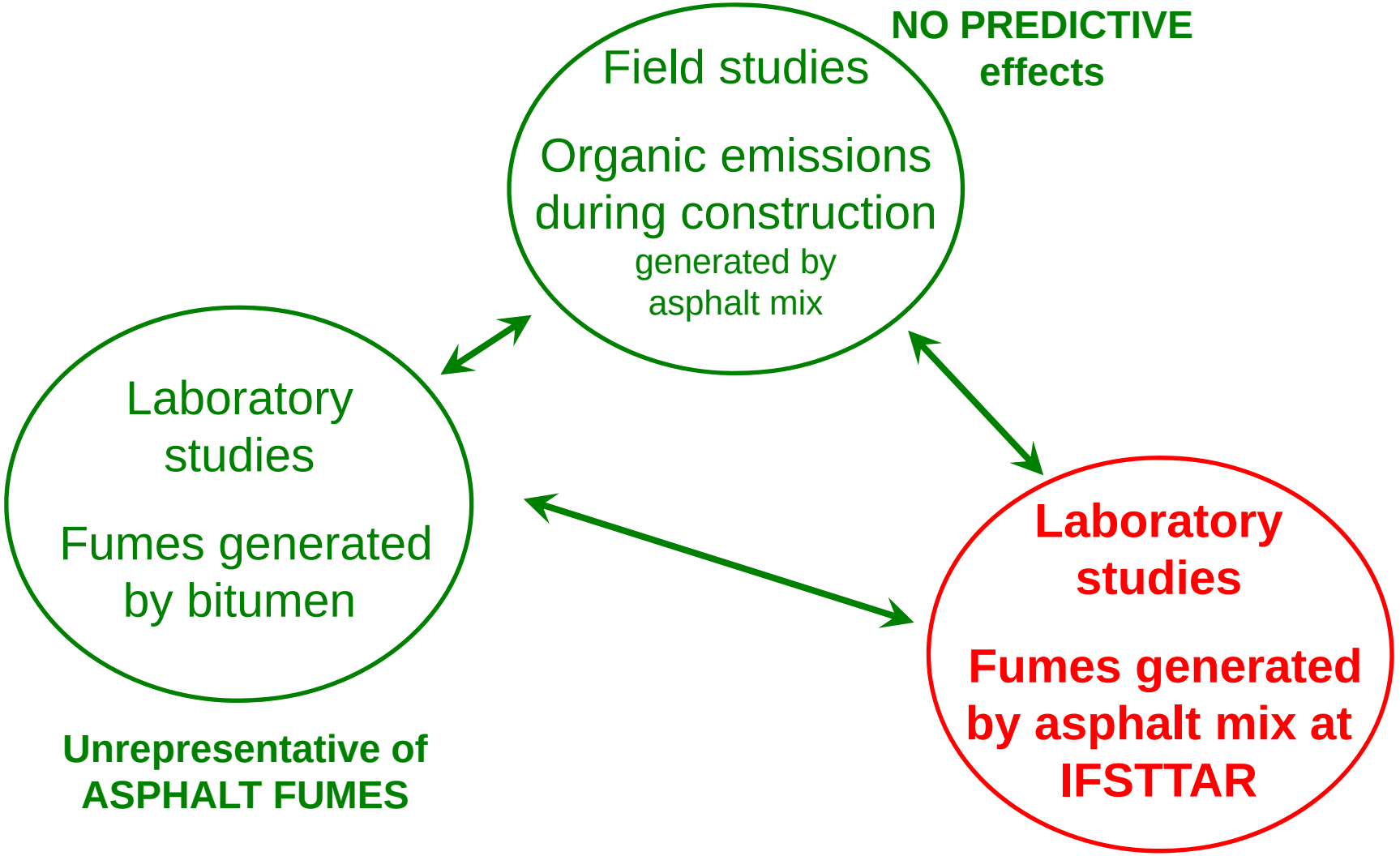
Organic emissions during construction

Asphalt mixes emissions

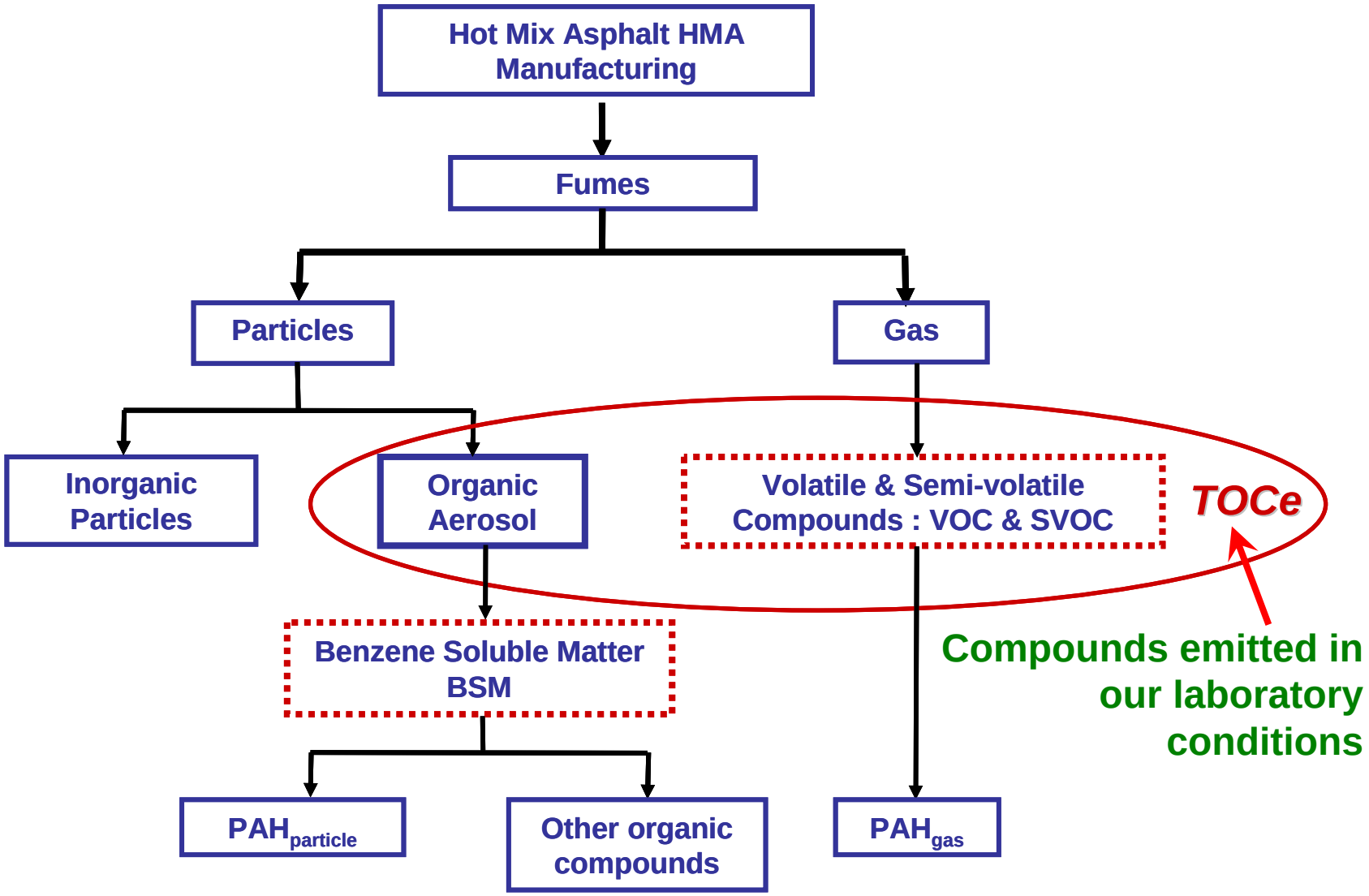
Production site (Drum mix plant)

Implementation site

Emissions in laboratory



Composition of bituminous fumes



IFSTTAR experimental method

Objective

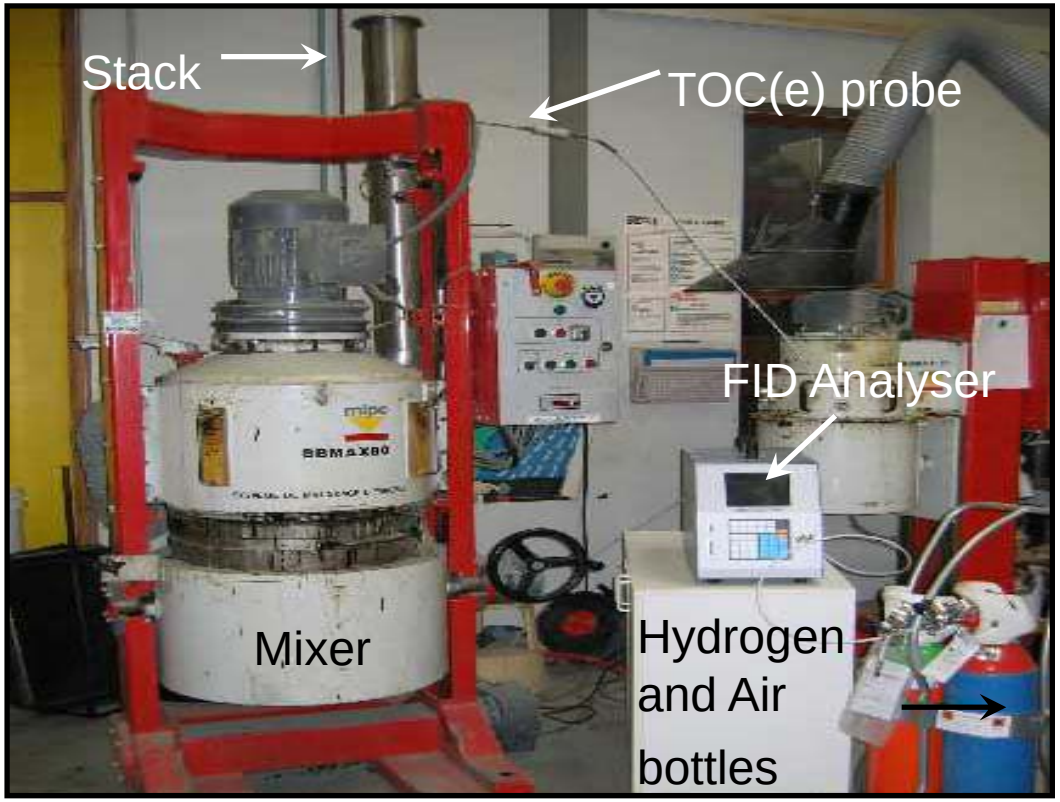
Environmental Assessement and ranking of **bituminous mixes** in lab

Functions

- Generate fumes
- Collect / Sample
- Analyse

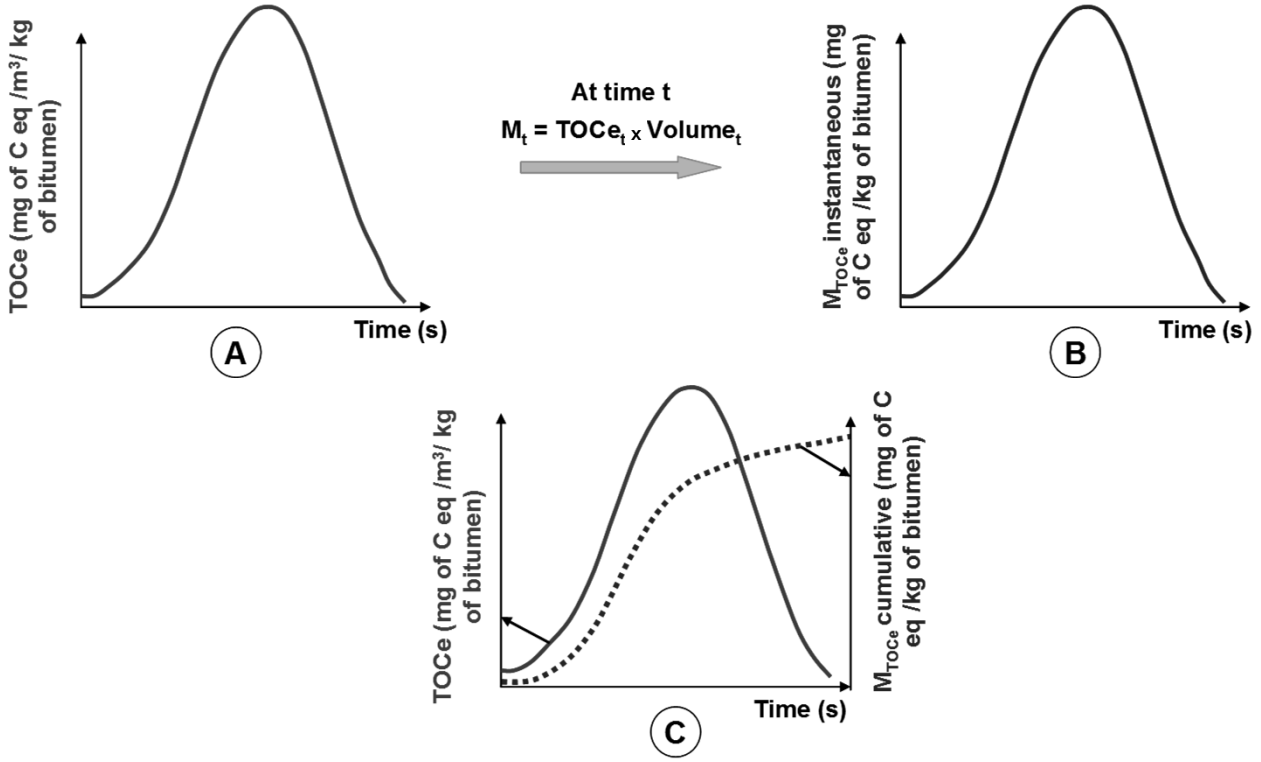
Parameters studied

- Formula
- Binder
- Process



TOC(e) quantification

- Portable and automatic total hydrocarbon equipment
- Evaluation and separation of TOC by a Flame Ionization Detector
- Evolution of Total Organic Compounds TOC(e) emissions according to time

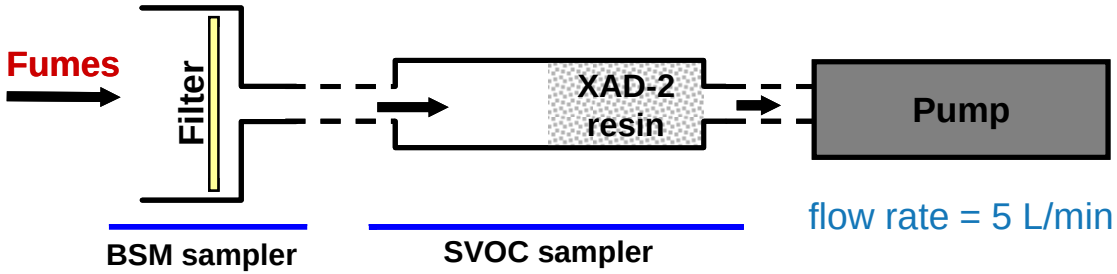


SVOC and BSM Quantification

Adapted filters system (XAD-2 resin et PTFE filter)

Outputs : Semi volatil and benzene soluble matter concentration, PAH concentrations

Towards an identification of chemical compounds in fumes



New methodology to study fumes

Manufacturing

Transfert to the finisher

Transfert to the finisher

Finisher screw

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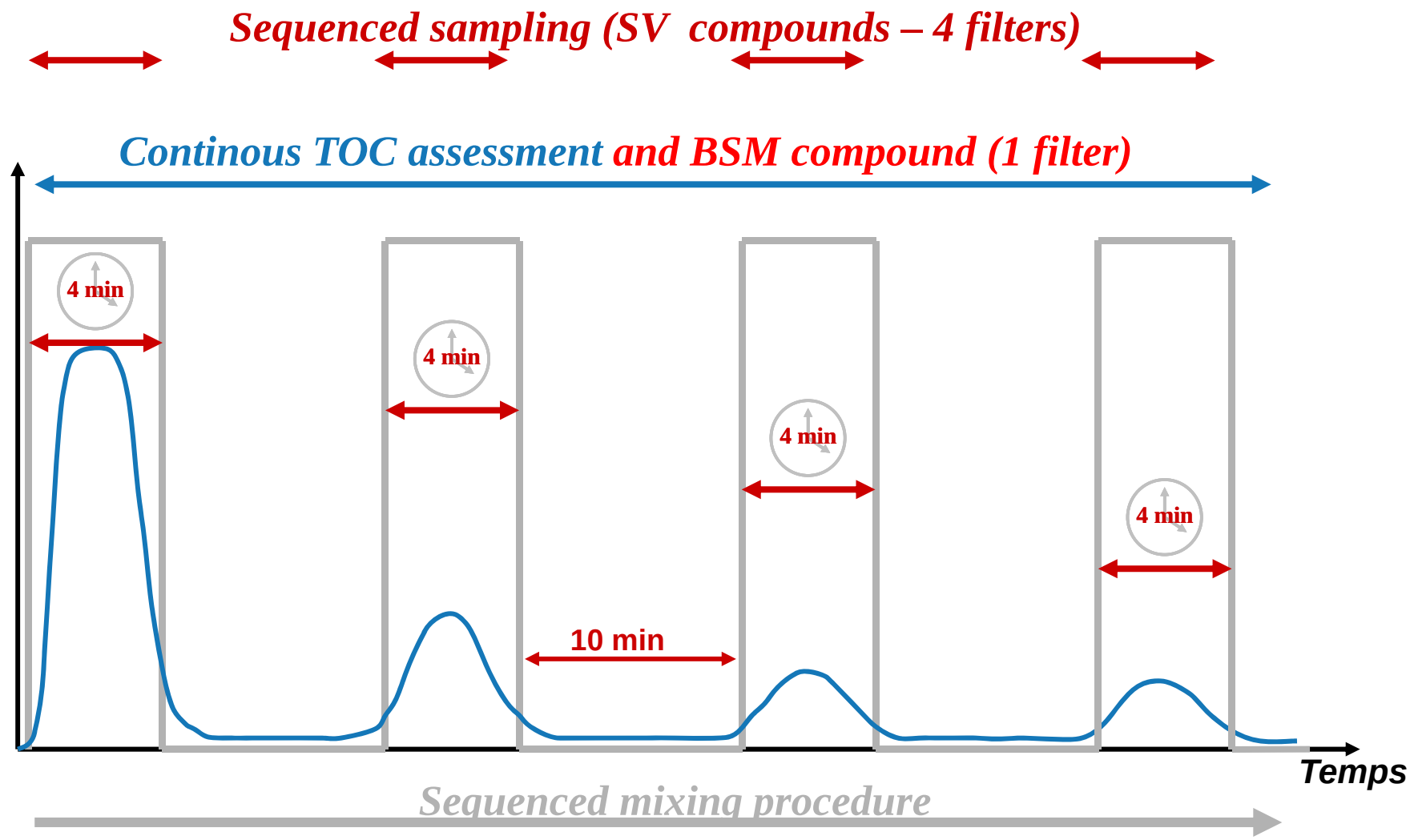
FEHRL

Sampling protocol



Objectives of the study

- Identify the effect of bituminous material composition on emissions
  - Influence of binder (pure or modified by polymer)
  - Chemical binder nature in RA (contamination by tar)
  - Amount of RA (0, 15 and 30 %) in the mix formula

Properties of SMA11S and RA

Formula studied : German SMA11S, Total binder content 6.5%

Material	Temperature
Binder	160°C
Virgin aggregate	180°C
Reclaimed asphalt	130°C (one night)
Manufacturing mix	**145°C**

Sieve (mm)	RA origin and pass (%)		
	Germany	Sweden	Ireland
0.063	6.8	2.6	7.8
0.125	10.0	13.0	11.0
0.25	14.7	20.0	14.0
0.5	-	28.0	19.0
0.71	25.9	-	-
1	-	35.0	23.0
2	33.4	46.0	31.0
4	-	63.0	42.0
5.6	63.4	77.0	50.0
8	92.1	93.0	67.0
11.2	98.9	100.0	98.0
16	100.0	100.0	100.0
Binder content (%)	8.20	6.10	4.95

Added binders

Pure

- Pen-grade 35/50, French origin and paraffinic one

Modified

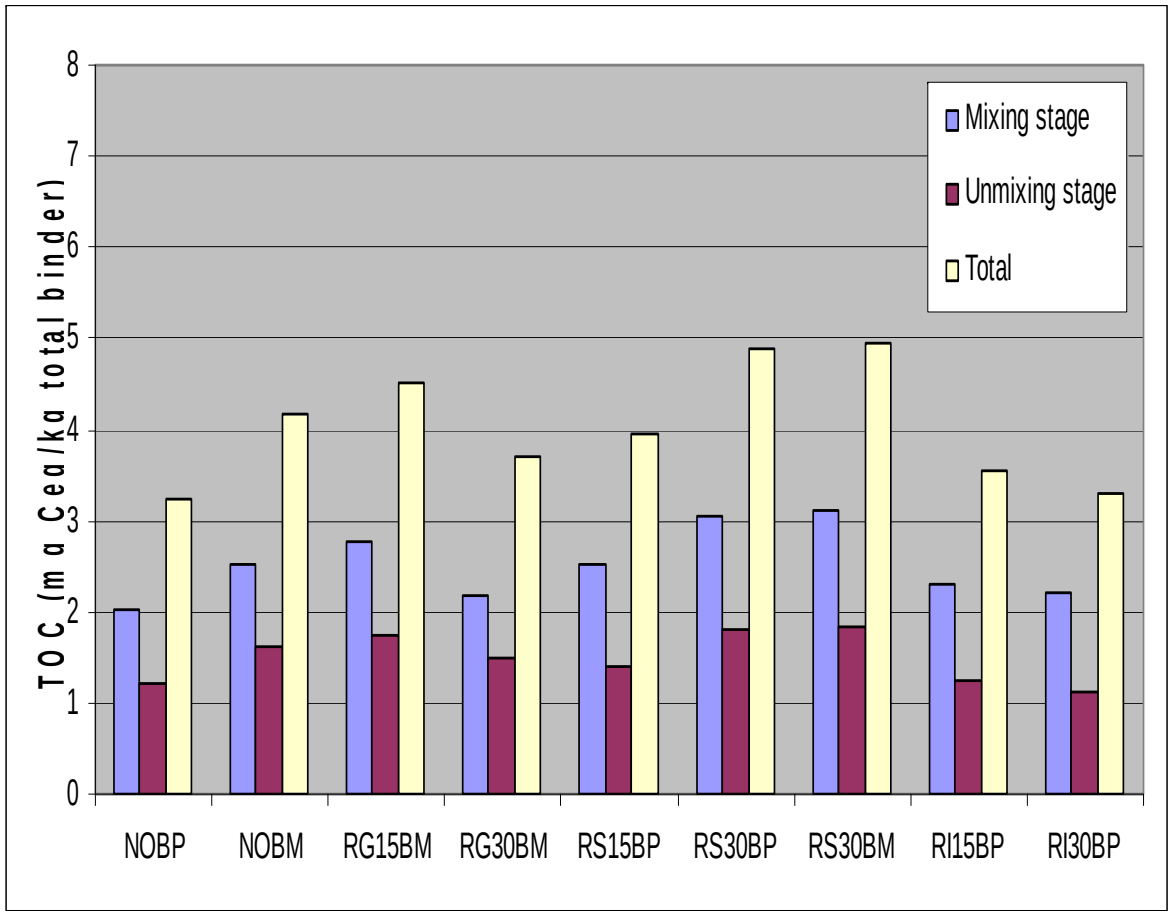
- PMB 25/55-55A, German origin

Tar presence in the Swedish RA

Materials studied

Ref	RA origin (-)	RA content (%)	Pure bitumen (-)	Modified bitumen (-)
NOBP	-	0	BP	-
NOBM	-	0		BM
RG15BM	Germany	15	-	BM
RG30BM	Germany	30	-	BM
RS15BP	Sweden	15	BP	-
RS30BP	Sweden	30	BP	-
RS30BM	Sweden	30	-	BM
RI15BP	Irland	15	BP	-
RI30BP	Irland	30	BP	-

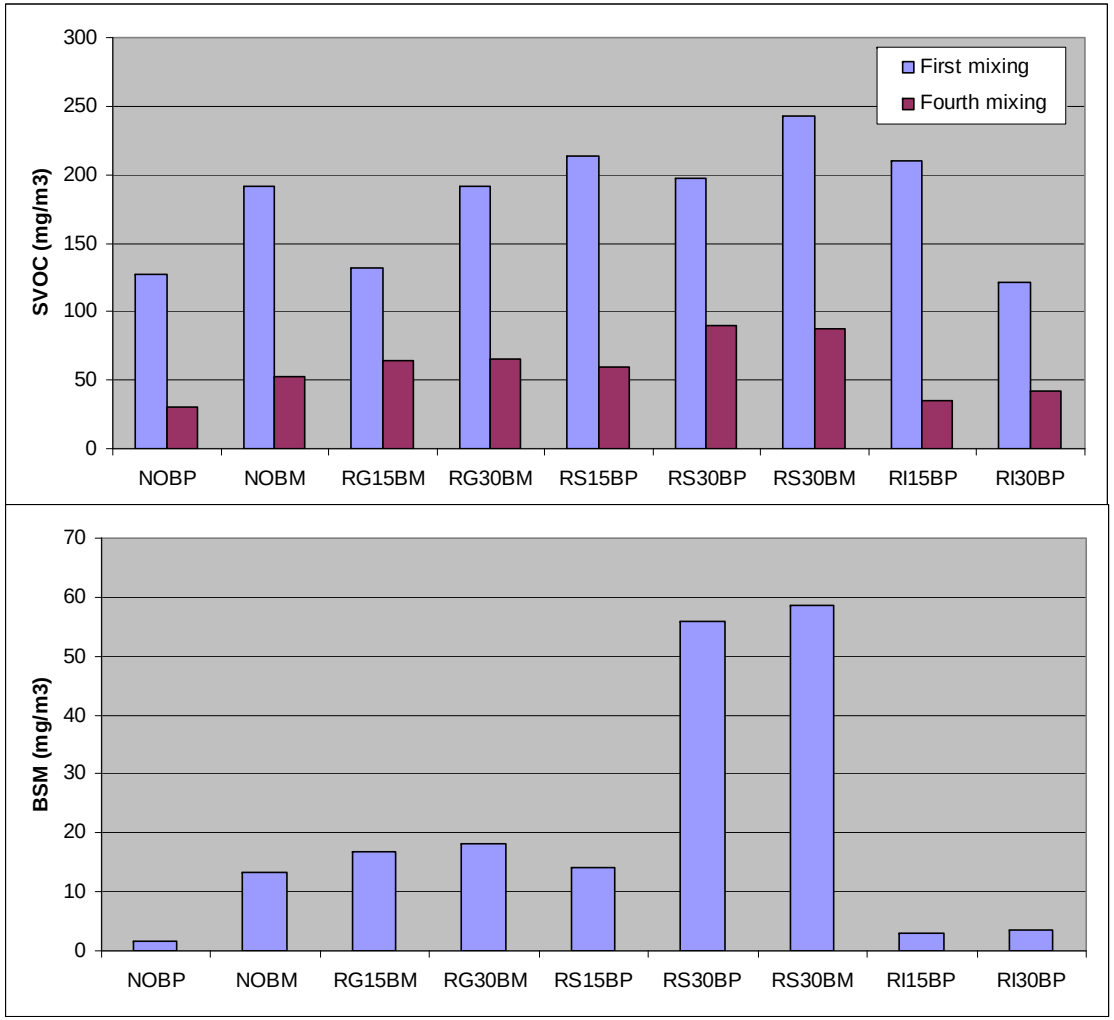
TOC results



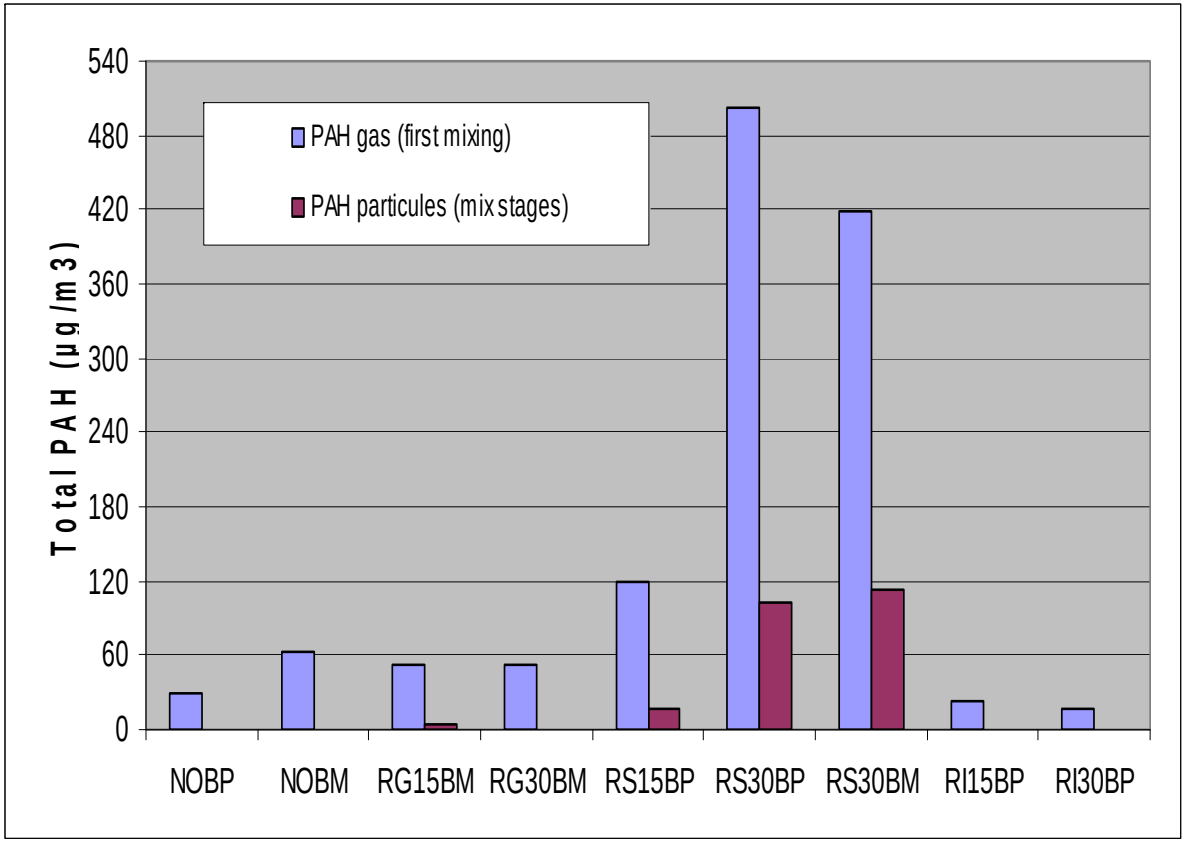
- Cumulated TOC mass are linked to mix composition
- Mix generated more TOC during mixing step (4 min each) than during unmix steps (10 min each)
- Tar-Contaminated mixes generated higher TOC concentration
- No evidence of RA content influence on TOC (except RS series)

SVOC and BSM results

- Influence of mixing sequence number on semi volatile organic compounds concentration
- At 4th mixing sequence (finisher screw), contaminated materials generated more SVOC
- Contaminated mixes generated much more BSM in fumes
- For RA without Tar, binder type influences results
- Evidence of RA content influence



Total PAH concentrations



- Quantification of Total PAHs in gas and particulate part of fumes
- Contaminated mixes generated much more PAHs
- PAH Gaz (resin) Naphthalene has been detected and quantified
- PAH Particules (filter) Benz[a]anthracene and Benzo[a]pyrene have been detected but not quantified

Conclusions

IFSTTAR Fume generator enables identification of bitumen fume quantity and quality in relation to asphalt constituents

Fumes have been evaluated throughout TOCe, SVOC, BSM, PAH gas and PAH particles on differents mixes heated at 145ºC

Mix composition influence airborne emissions

- Tar contaminated RA and Binder modified bitumen increases emissions
- The most emissive mix is composed of Swedish RA with a RA content of 30%.