

France's Perspective on Warm Mix: Research and Practice

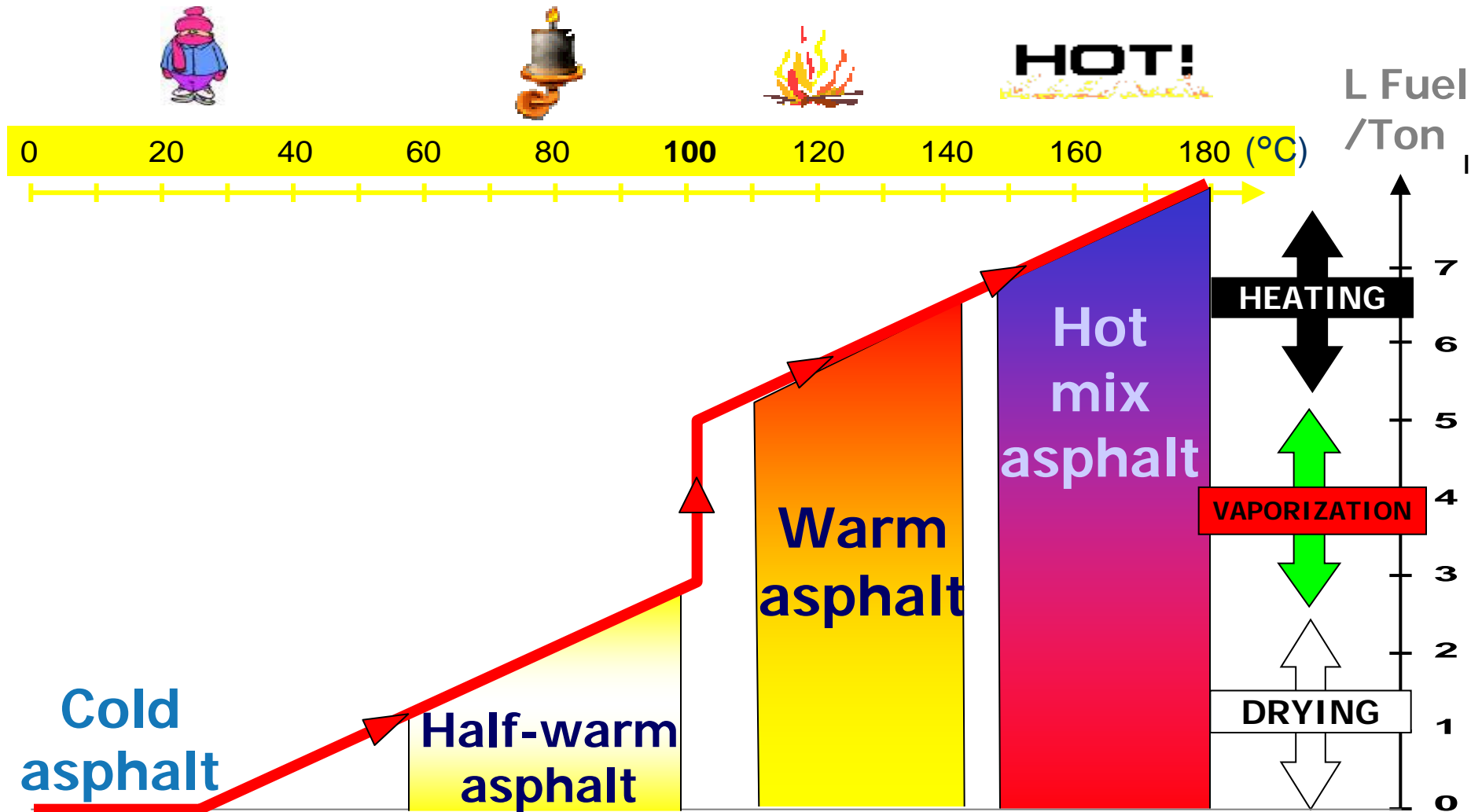
Vincent Gaudefroy

IFSTTAR - France

Definition of Warm Asphalt Mixes

- Any practical/technical mean
 - To allow reduction of manufacturing and/or laying temperature
 - While keeping the same performances as Hot Mix Asphalt
 - With final performances achieved just after laying and cooling

Terminology



Current practice of Warm asphalt in France

Development of WAM in France

- First studies and researches : 2000-2003
- Experimentation : 2002-2005
- Industrialization : since 2004-2006
 - Applications in various conditions
 - Any type of network, traffic, climate
 - Any type of material (surface or base course)
 - New construction and maintenance

Types of processes used in France

- Use of binder additives to modify binder/aggregate interface and ensure coating at low temperature
- Use of bitumen foaming (pressure or not)
 - By keeping residual water in the aggregates
 - By using water in aqueous phase , ...
- Use of sequential coating steps

Available products in France (2011)

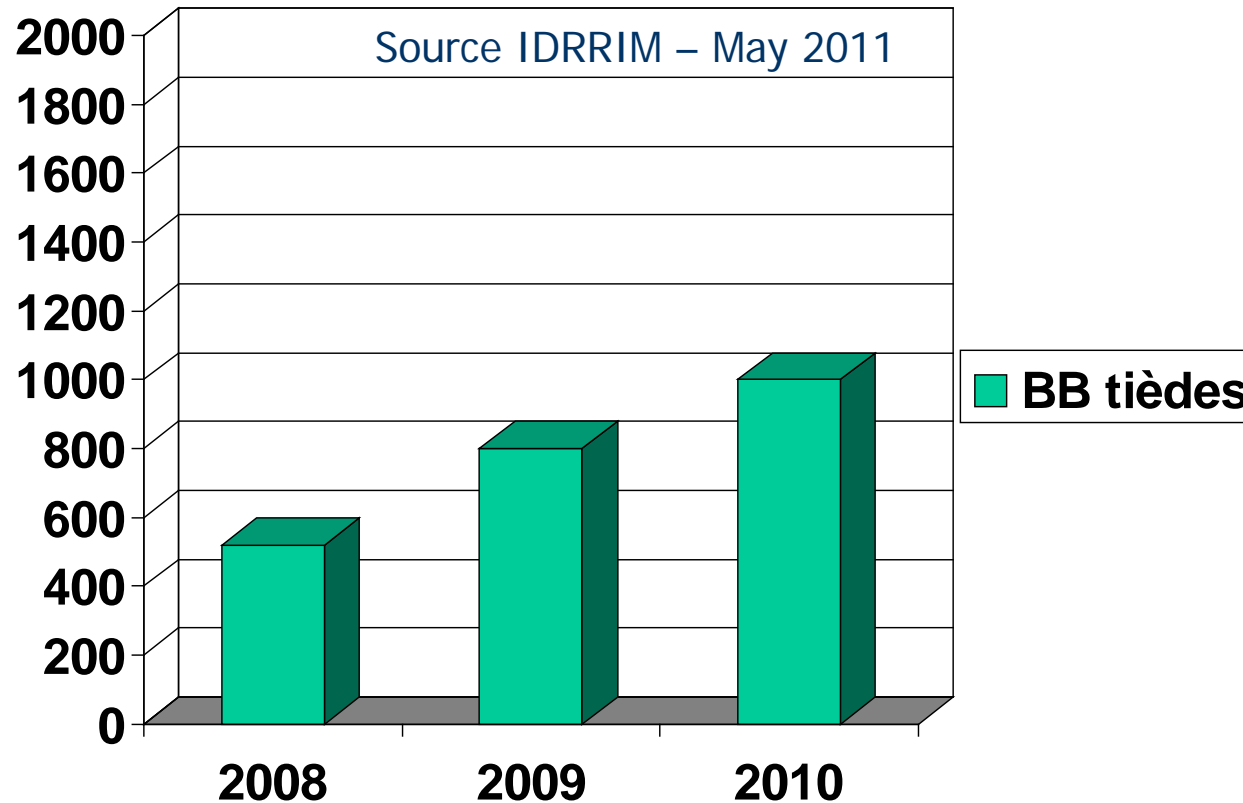
Technique	Name	Manufacturing temperature reduction (°C)	Company
Binder Additive	ETIMA	30 to 45	MALET
	3E - LT	30 to 45	COLAS Group
	EVOTHERM MA3	30 to 45	EUROVIA
	EBT 130°C	30 to 45	EIFFAGE Travaux Publics
Foaming process	EVOTHERM DAT5	40 to 60	EUROVIA
	EBT 130°C	30 to 45	EIFFAGE Travaux Publics
Foaming process and sequential coating	EBT 90°C	50 to 80	EIFFAGE Travaux Publics
	EBE	50 to 80	Operating licence (owner LEA-CO)
	EBT 130°C	30 to 45	EIFFAGE Travaux Publics
	WAM-FOAM	Up to 60	Operating licence (owner SHELL)
	3E - DB	40 to 45	COLAS Group

In addition : Increase of foaming processes (from US – Astek, Gencor, Maxam)
 Development of specific binder by French bitumen company (Total)

Consequences for asphalt plants

- No modification for specific binders or additives in bitumen
- Necessary modifications (more or less important) for
 - Foaming
 - Double coating
- Sometimes necessary reduction of production rate

Examples of quantitative evolution



Approximately near HALF million ton applied in 2008,
2010 : ONE million ton in France among 40 millions tons/year of HMA

First assessment of French survey of WAM

- In laboratory
 - Mechanical performances are similar as HMA
 - But stripping resistance (Duriez test) is slightly lower than HMA
- Manufacturing in plant
 - Production temperature from 90°C to 130°C
 - Residual moisture control seems difficult (for 'water' processes)
- Implementation and laying
 - Laying and compaction temperature from 70°C to 120°C
 - High compaction energy is required especially for base course
 - Workability at middle term must be monitored
- Environmental field
 - Reduction of emissions
 - Reduction of energy consumption

Current research activities on WAM

Research needs

- Assess global energy consumption vs. traditional HMA
- Assess fume emissions reduction (effect of additives/binder)
- Assess coating quality in lab
- Assess durability under traffic
- Assess aging properties
- Assess usability of performance-based specifications (representativeness of laboratory manufacturing process vs. plant process)

LCPC Research project 'OPTIMIRR' 2006 -2012

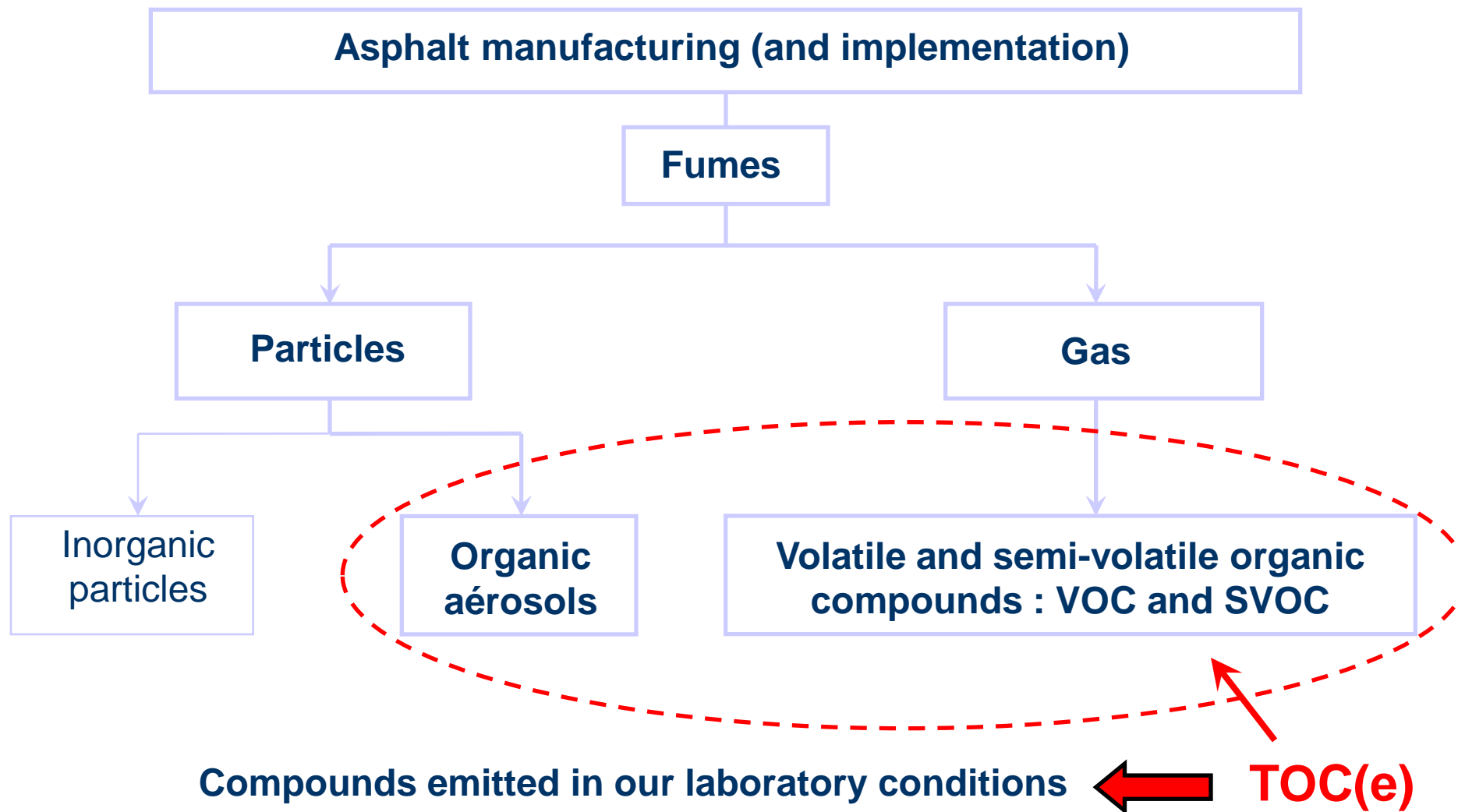
Optimization of Pavement Materials and Reclaimed Asphalt Pavement Incorporated into Roads

- WAM = Environmentally friendly processes ?
 - Aggregates (partly or fully) heated
 - Bitumen temperature still high
 - Complexity of Mixing processes
 - Additives (paraffin, zeolites, ...), recyclibility?
- Foaming bitumen with steamed water: 'stripping effect' = ecologic benefit ?
- Residual water content in warm mix : aggregate/bitumen interface durability, long term behaviour under heavy traffic ?



Lot's of questions waiting for answers
>> Researches in progress

Asphalt fumes



LCPC Asphalt fumes generator

Objective

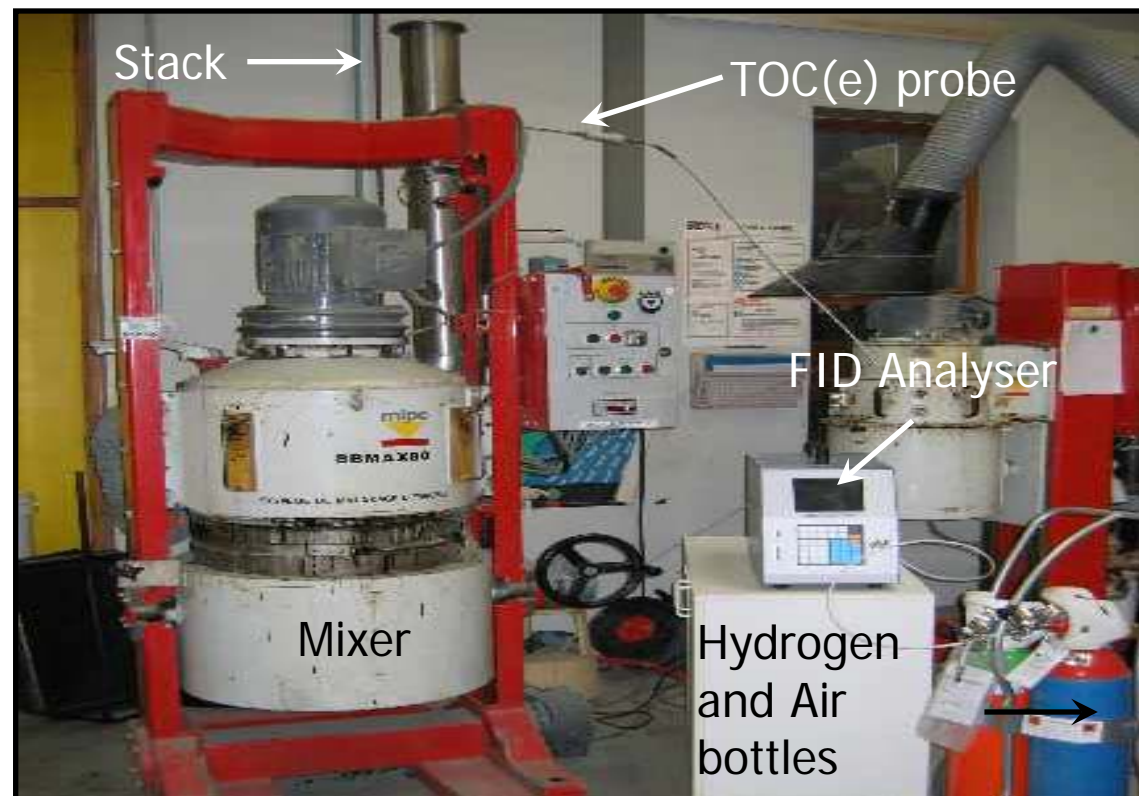
Environmental Assessment and ranking of **bituminous mixes** in lab
Efficient laboratory tool to study and **forecast** asphalt fumes

Functions

- Generate fumes
- Collect / Sample
- Analyse

Parameters studied

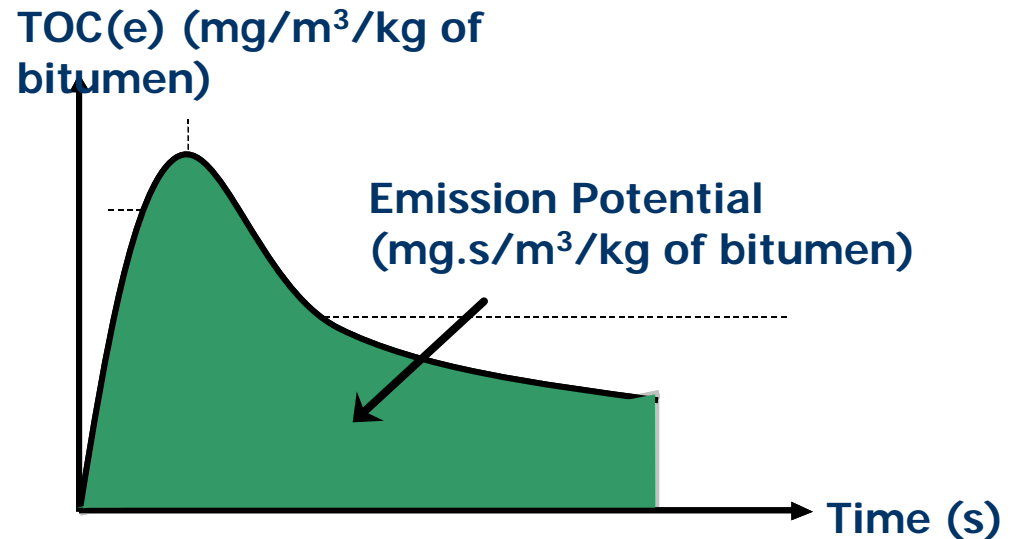
- Mix design
- Binder
- Process
- Manufacturing temperature



Analytical systems to measure asphalt emissions

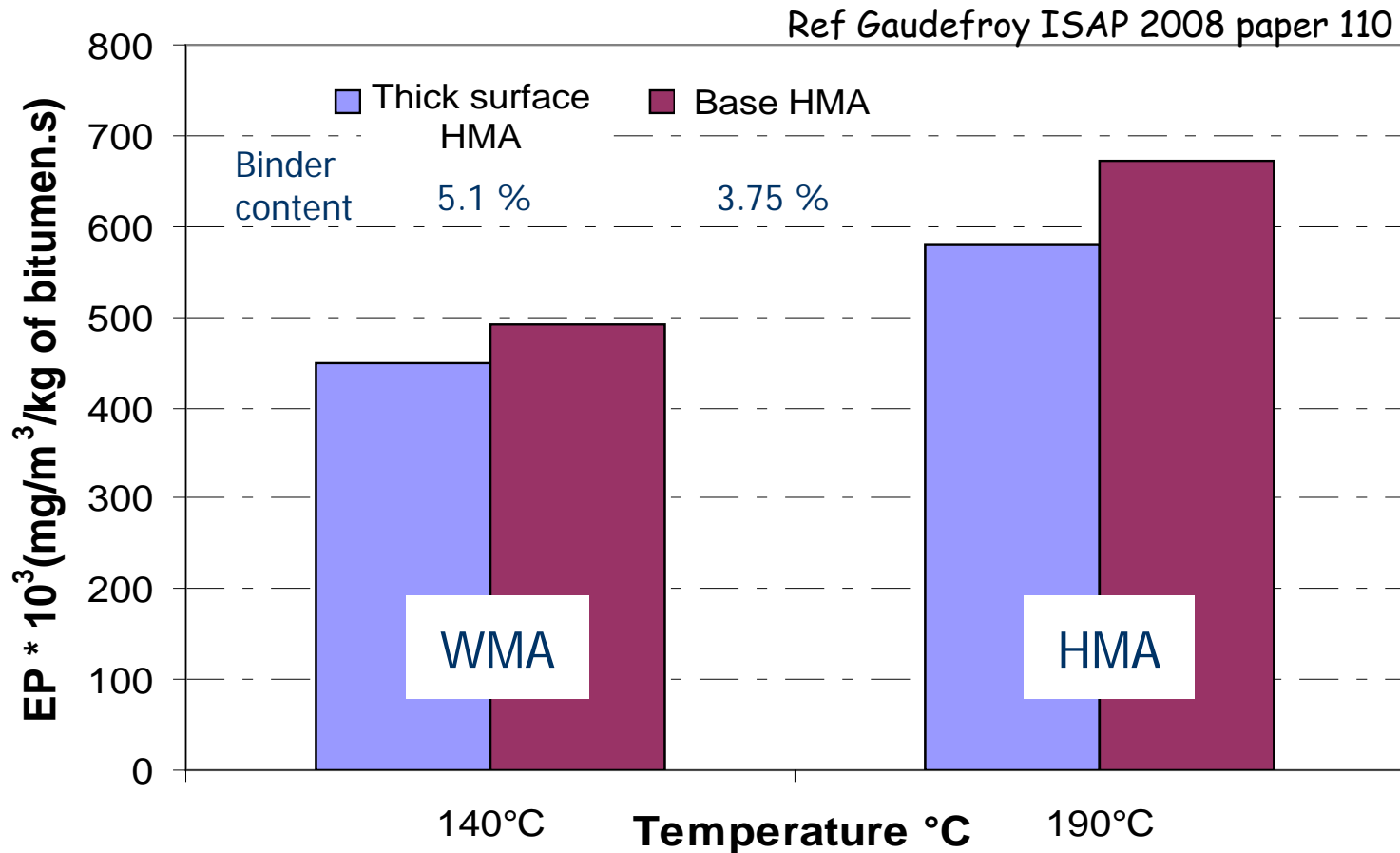
- Evaluation and separation of TOC by a Flame Ionization Detector (FID)
- Evolution of Total Organic Compounds TOC(e) emissions according to time at a stirring velocity of 20 rpm

One studied indicator
= Emission Potential



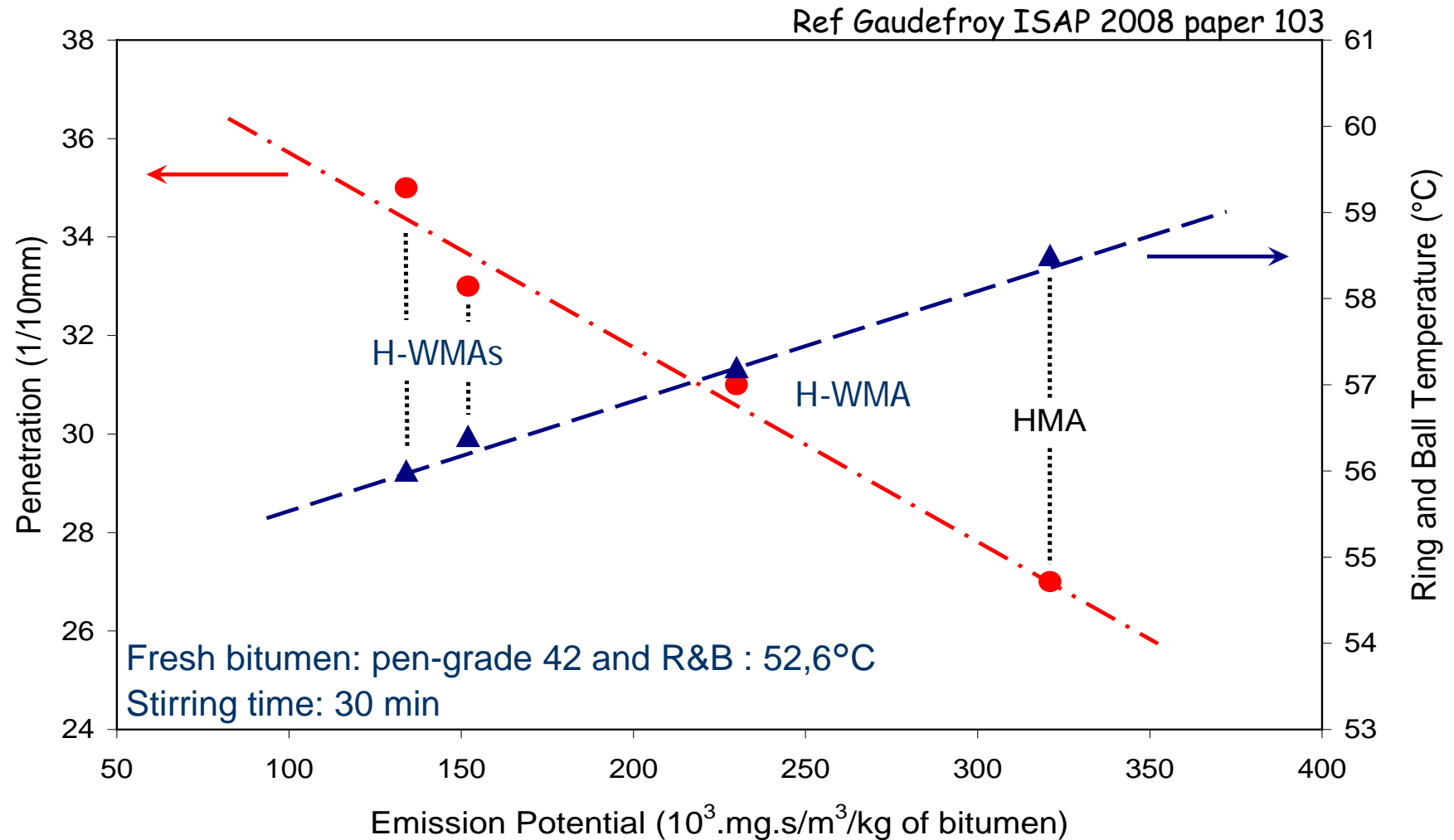
The emission Potential (EP) is calculated by integrating the area under TOC(E) curve according to time

Temperature and mix design influence



Increase of Temperature = Increase of TOC(e) emission

Bitumen aging and fumes emissions



Correlation between Emission Potential and bitumen aging

Durability and performances of WMA

- Survey of existing job sites
 - French expert task group on 'WMA processes' of SETRA (road directorate)
- Accelerated Pavement testing to assess durability under traffic



- Enabling to check performance based specification applicability for WMA

Conclusions

- WMA durable trend in France
 - Increasing use with promising results
- Still research needs
 - Need of a global environmental assessment tool (like for other techniques)
 - Existing experiments on site for fume assessment to correlate to laboratory
 - Need for job sites surveys
 - To assess durability under traffic
 - To check and/or improve performance based specifications for these mixes

**Thank you for your
attention !**

contact :
vincent.gaudefroy@ifsttar.fr
yves.brosseaud@ifsttar.fr