The Green Chemistry in Road Industry

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Summary

Green Chemistry general concept

- Definition
- Implementation in Road Industry

An exemple from COLAS Innovation

- AFM emulsifier range : characteristics / advantages
- Recent jobsites references

CECA/EIFFAGE Collaboration: A 100% biosourced CRS emulsifer

- Chemical Synthesis
- Jobsite references since 2005

Conclusions and perspectives

GREEN CHEMISTRY

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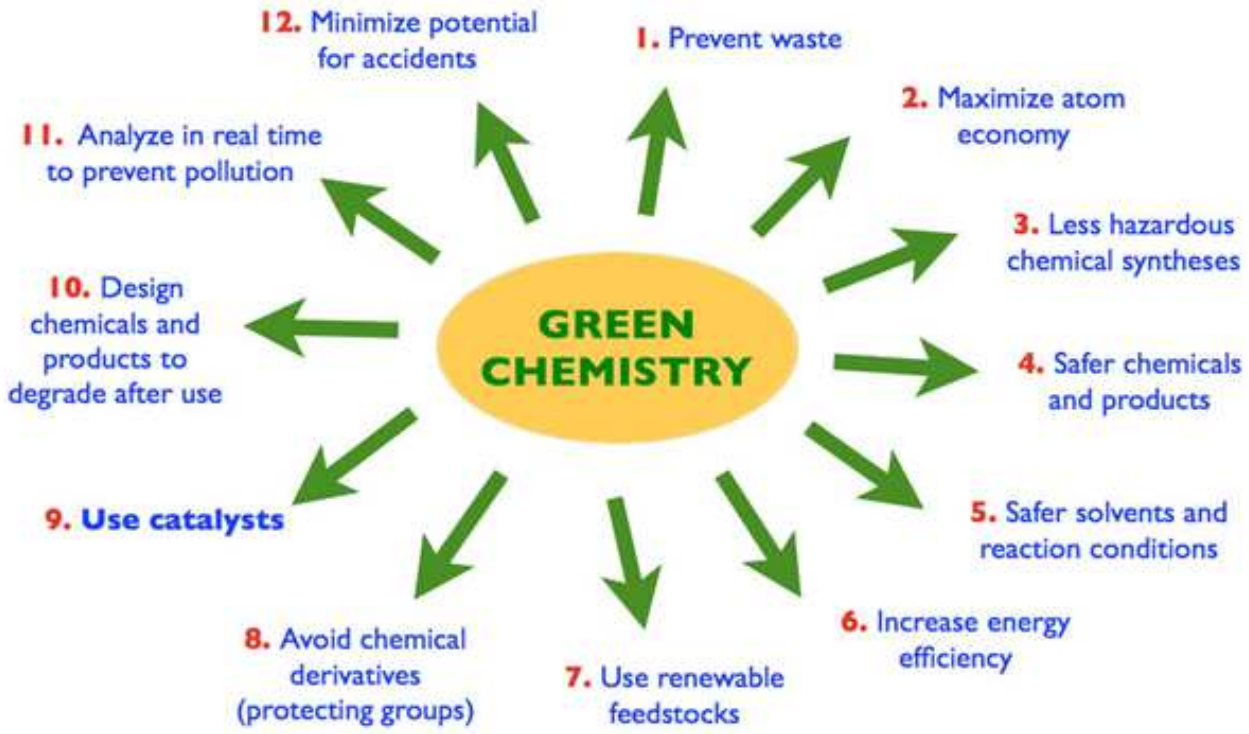
The concept
Implementation in Road Industry

Green Chemistry definition

› 12 principles for a better sustainability in chemistry science

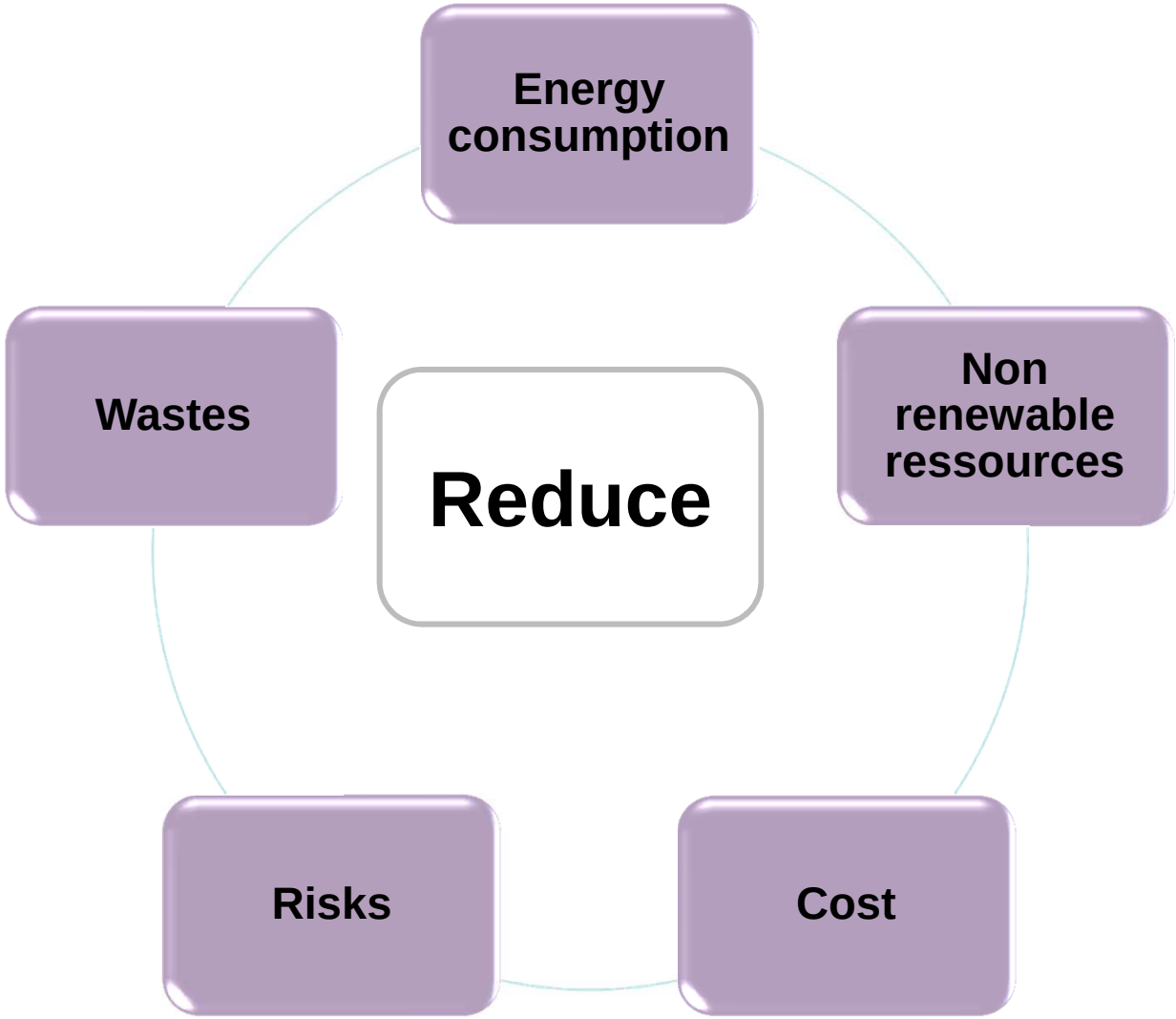
› Paul T. Anastas & John C.Warner,

Green Chemistry , Theory and Practice Oxford University Press, New-York, 1998



Anastas and Warner (1998)

Green Chemistry definition



Implementation in Road Industry

› Binders based on vegetal ressources

› Vegetal fluxoils as alternative to volatile mineral oils

-> no VOC emission

› Chemical additives efficient for lowering the temperature of mixes

› Valorization of wastes / Recycling

› New range of emulsifiers → 2 exemples

COLAS/CHEMORAN

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AFM emulsifier range

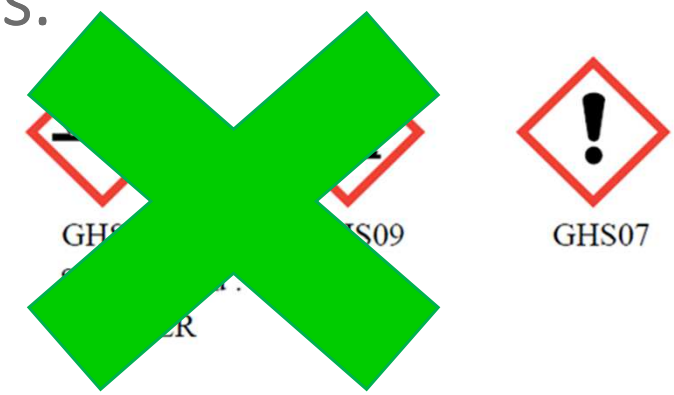
Field experimentation : jobsite references

What is AFM ?

- 83% bio-sourced
- Neutral emulsifier
- Can be used directly in bitumen emulsion manufacture without any activation by acid or base.
- Therefore much safer to handle during bitumen emulsion manufacture
- Alternatively can also function as either a cationic or an anionic emulsifier

Advantages to the use of AFM

› Labelling more consumer and environmentally friendly than the normal fattyamine / fattyamidoamine emulsifiers used traditionally in bitumen emulsions.



› Non-hazardous for transport.

Chip seal / Tack coat

› Neutral pH emulsion

› Perfect tackiness on concrete support

› Good behaviour in spite of wet environment

Reference job site : Tunnel Maurice Lemaire – East of France
34 000 m2

Dust palliative

- 60% fluxed bitumen emulsion
- Very good emulsion stability → destabilization avoided after dilution with 95% water
- No environmental risk because of neutral pH

Reference job site (Dust a Side) :
GORO Mining site in New Caledonia
18 000 m2

Soil Stabilization

- Anionic Slow Setting emulsion
- Can be mixed with cement
- Used mainly for mixing with natural gravels or crushed aggregates for the stabilization of base coarses

Reference job site :

A track in Kruger National Park (Colas South Africa)

Assessment of the experimentations

› AFM vs "standard" surfactants

- **Standard emulsion manufacture process**
- **Can replace standard surfactants for medium /slow setting emulsions**
- **Safer during manufacturing and application**

EIFFAGE TP / CECA

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Biosourced emulsifier for surface dressing
Field experimentation : jobsite references

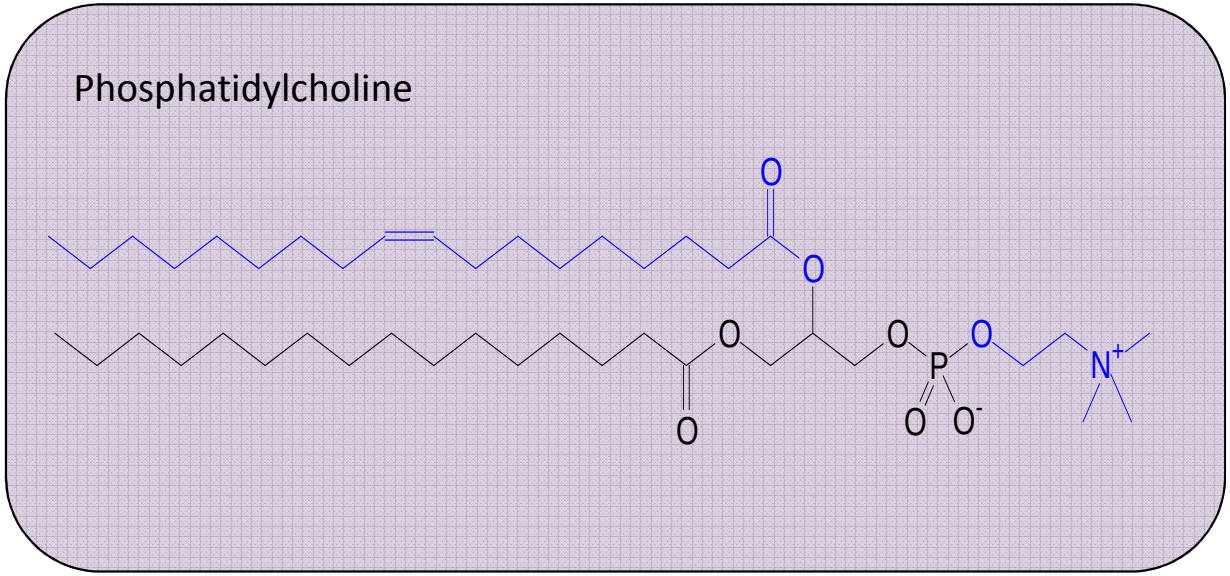
Cationic “eco-friendly” bitumen emulsifier

› Main characteristics :

- Bio-sourced and renewable raw materials
- Biodegradable
- Low toxicity

Inspired by nature..

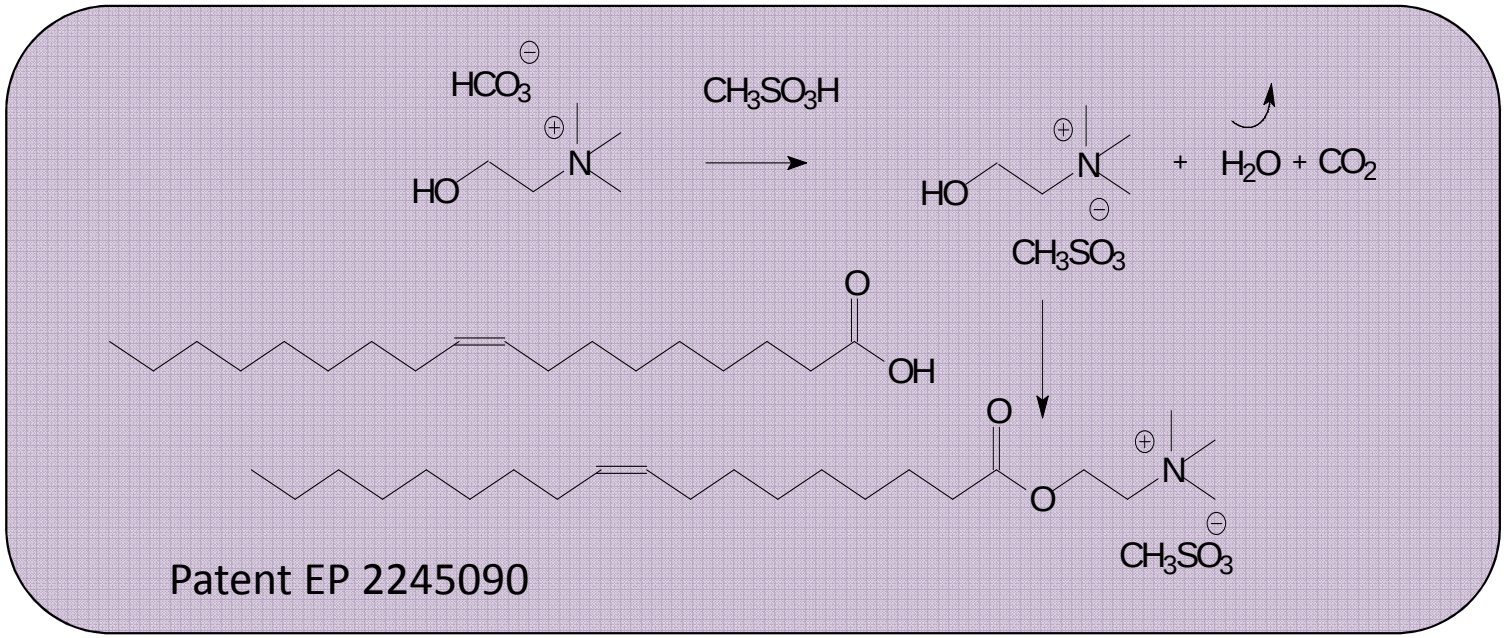
(Soybean, egg yolk…)



Cationic “eco-friendly” bitumen emulsifier

› Sustainability without sacrificing economics

- Based on vegetable oil and choline



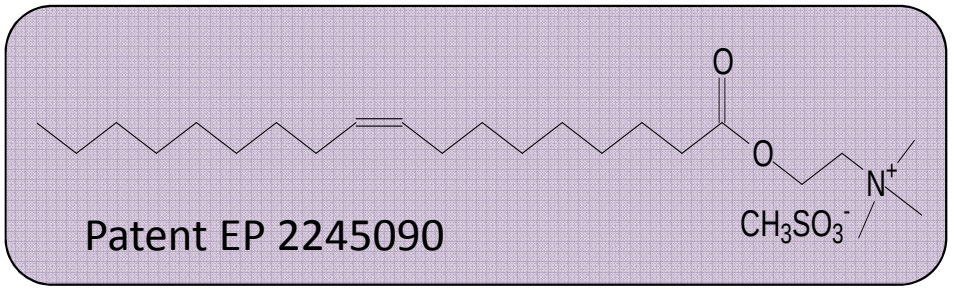
- Green chemistry : no solvent, low temperature…

Cationic “eco-friendly” bitumen emulsifier

› Biodegradable with low toxicity

Biodegradability OECD 301D	73%
Toxicity to algae OECD 201	2.6 mg/l
Toxicity to fish OECD 203	7.1 mg/l
Toxicity to daphnia OECD 202	1.2 mg/l

- H315 : Causes skin irritation.
- H319 : Causes serious eye irritation.
- H335 : May cause respiratory irritation.



Patent EP 2245090

- **First experimentation in 2009**
  - *Located in France (rural area)*
  - *Traffic cat. (T4) : 25 to 50 trucks / day*
  - *Surface = 16 000 m²*

- **Double prechipped surface dressing**
  - *Pure bitumen emulsion*
  - *Bitumen content : 65%*
  - *Layers emulsion content : 1,8 & 1,9 kg/m²*
  - *Agregates (2/4 - 6/10 – 10/14) : ~8 l/m²*

- **Last experimentations in 2014**
  - *2 worksites (rural area)*
  - *Located in France*
  - *Traffic cat. (T3$^-$) : 50 to 85 trucks / day*
  - *Surface = 25 000 m²*

- **Double surface dressing**
  - *Pure bitumen emulsion*
  - *Bitumen content : 65%*
  - *Layers emulsion content : 1,4 & 1,1 kg/m²*
  - *Aggregates (6/10 – 4/6) : 7 & 5 l/m²*

Assessment of the experimentations

› Positive experiences

Following during 5 years no defects observed

› PX10016 vs « standard » surfactants

- ✓ **Same emulsions design & equivalent performances**
- ✓ **Surfactant rate : slightly higher with PX10016**
- ✓ **Cost effectiveness still in favor of traditional products**
- ✓ **Scaled up productions of the product will minimize this difference**

GENERAL CONCLUSION | 4

Ready for the Future

- **Successfull Jobsites experimentations**
- **Safer products (environment – hazard)**
- **Balance between economical parameters and future legislation on HSE, transportation etc…..**

Thank You for your attention