

Development of heavy-duty degreasers with low CLP labelling

Microemulsions Part II

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Classification, Labelling and Packaging (CLP)

- New symbols and phrases (*Hazard* and *Precautionary*)
- New limits



Alcohol Ethoxylates

DSD

- Xi: irritant



- R41: Risk of serious damage to eyes

>= 10%: R41

>= 5%: R36

< 5%: No labelling

CLP

- GHS05: Corrosion



- H318: Causes serious eye damage

>= 3%: H318

>= 1%: H319

< 1%: No labelling

Fatty Acid Esters

- Benefits compared to hydrocarbon solvents:
 - Fatty acid esters are label-free
 - Fatty acid esters are readily biodegradable

White spirit

H304: May be fatal if swallowed and enters airways

H372: Causes damage to organs through prolonged or repeated exposure (central nervous system)



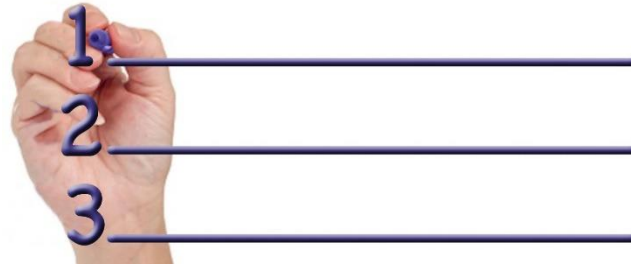
Solutions

- Replace hazardous solvents with harmless/less harmful solvents
 - Fatty acid esters instead of hydrocarbons
- Use other surfactants
 - Replace alcohol ethoxylates
- Oil-in-water microemulsions
- Water-in-oil microemulsions



Water-in-Oil Microemulsions

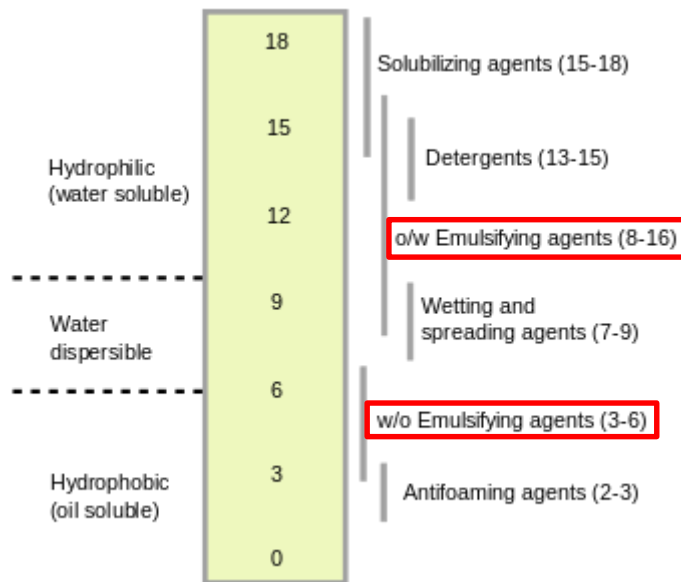
Setting Goals



- Emulsify as much water as possible using as little emulsifier as possible
- Good cleaning efficiency



Hydrophilic-Lipophilic Balance (HLB)



Bancroft rule:

The phase in which an emulsifier is more soluble constitutes the continuous phase

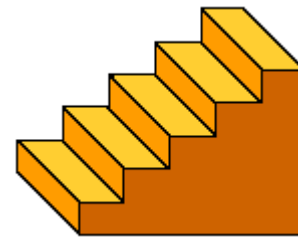


W.D. Bancroft



Development of W/O-Microemulsion

- STEP 1
 - Choose one or more fatty acid esters
- STEP 2
 - Identify suitable emulsifiers
 - HLB 3-6
 - Large lipophilic part – small hydrophilic part
 - 21 emulsifiers identified
 - Very few compared to emulsifiers for o/w emulsion



Development of W/O-Microemulsion

- STEP 3
 - Test solubility in fatty acid ester
 - Bancroft rule
 - 13 of 21 emulsifiers were completely or partly soluble



Development of W/O-Microemulsion

- STEP 4
 - Formulations based on Design of Experiments
 - 27 formulations containing a single or all 13 emulsifiers
 - Add small amount of water
 - No formulation containing a single emulsifier could emulsify water
 - Two emulsifiers (in combination with other emulsifiers) were good at emulsifying water



Development of W/O-Microemulsion

- STEP 5
 - Make 1:1 formulations of each of the two emulsifiers with another emulsifier
 - Test how much water each formulation could emulsify
 - Four emulsifiers identified as good at emulsifying water
- STEP 6
 - Formulations based on Design of Experiments
 - Not possible to model amount of water that could be emulsified
 - Two of 15 formulations looked especially promising

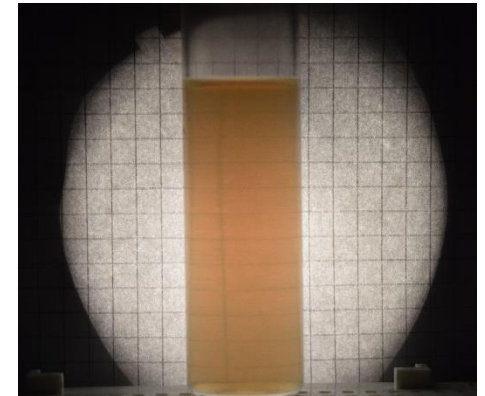


Development of W/O-Microemulsion

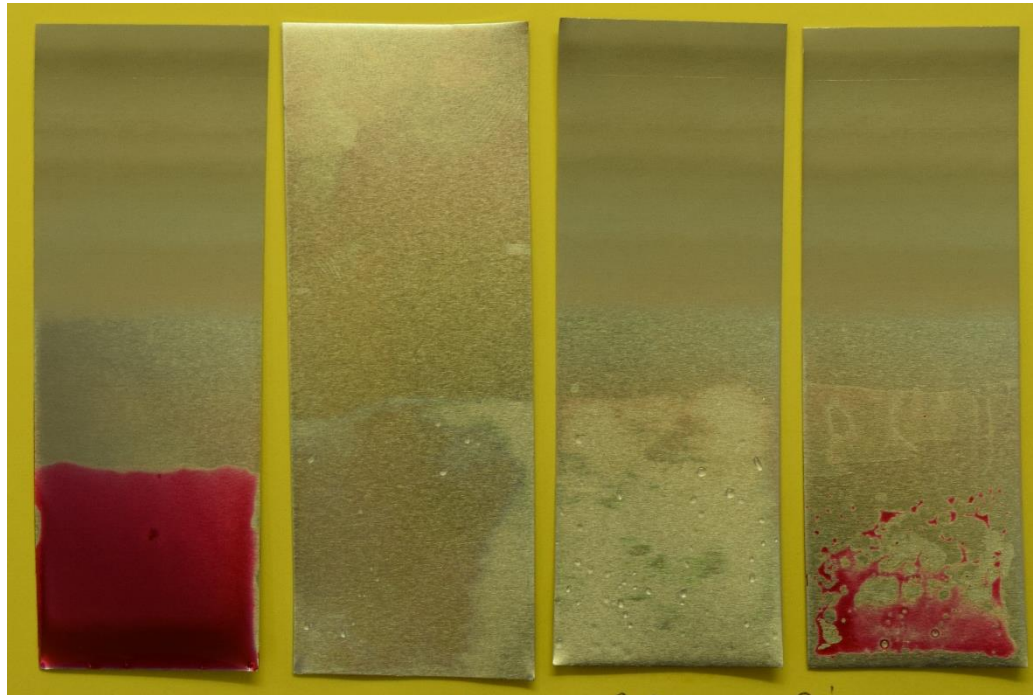
- STEP 7
 - Optimize formulations – choose one

Commercial Product: **ESTICLEAN AR**

- 40% water
- Stable -5 – 40 °C (higher with less water)
- Label-free



High viscosity mineral oil (with red dye)



EstiClean AR

D80

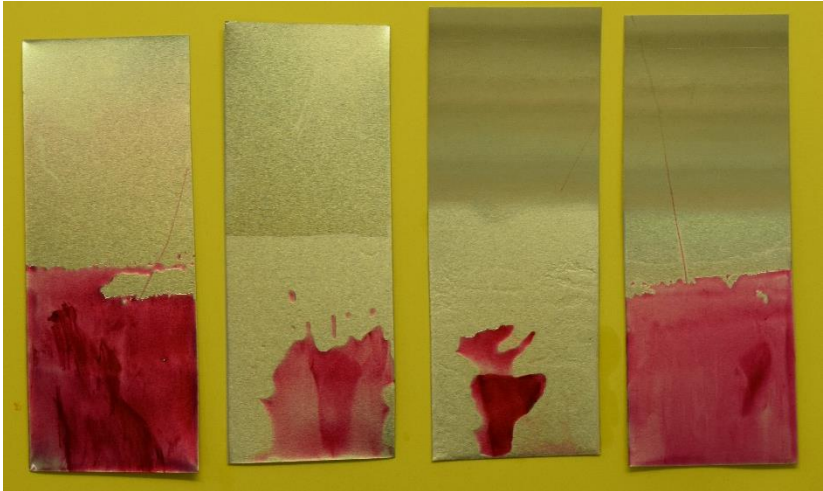
Alkaline degreaser



Handball Resin (with red dye)

Before wiping

After wiping



EstiClean AR

D80

Alkaline degreaser



O/W-Microemulsion

- Goal:
 - O/W-microemulsion with no labelling or H319 (Causes serious eye irritation) at 20% dilution
 - Good cleaning efficiency



Development of O/W-Microemulsion

- O/W-microemulsions a well-established technology
 - Many existing products
 - Based on alcohol ethoxylates (labelling issues)



Development of O/W-Microemulsion

- Identify other emulsifiers with low (H319) or no labelling
- Test emulsifiers
 - New emulsifiers could not replace existing emulsifiers 1:1
 - Formulation had to start from scratch



O/W-Microemulsion

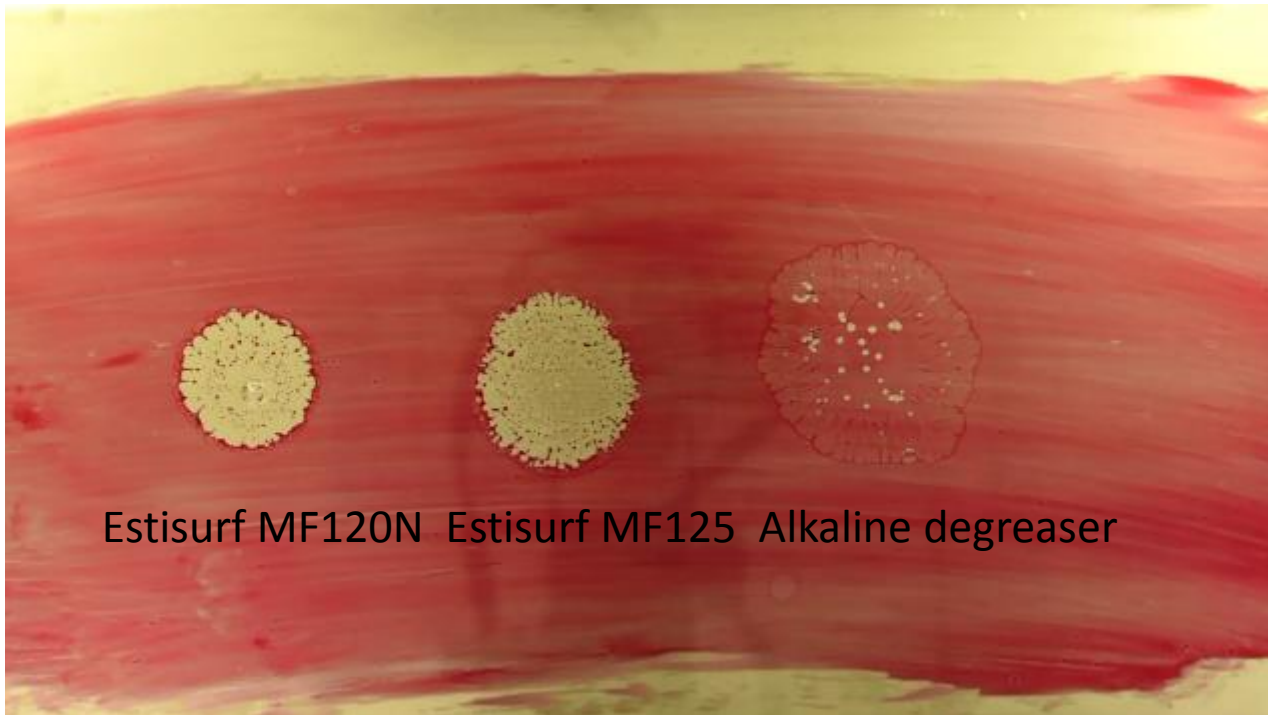
Two products developed:

- Estisurf MF120N
 - Label-free at 20% dilution
 - Cloud point: 35 °C; Krafft point: < -5 °C
- Estisurf MF125
 - H319 at 20% dilution
 - Cloud point: 34 °C; Krafft point: < 5 °C

Label-free



High viscosity mineral oil (with red dye)



Estisurf MF120N Estisurf MF125 Alkaline degreaser



Commercial product: ESTICLEAN AR

- w/o microemulsion, fatty acid ester as exterior phase
- Surprisingly good cleaning properties! - a true alternative to hydrocarbon solvents
- No CLP classification
- w/o formulation technique can be tailor-made to fit special customer projects



Commercial products: ESTISURF MF120N and ESTISURF MF125

- Ester/surfactant concentrate to be used as basis for formulation of o/w microemulsions
- Surprisingly good cleaning properties! – a true alternative to hydrocarbon solvents for metal degreasing
- No CLP classification or the “weak” H319 for the application concentration
- Formulation technique can be tailor-made to fit special customer projects

