

Roles of Inert Ingredients in Pest Control Products

EPA/CPDA Symposium on Inert Ingredients

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Huntsman Performance Products

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Common Types of Formulations (CIPAC* Nomenclature)

- CS** : Capsule Suspension
- EC** : Emulsifiable Concentrate
- EG** : Emulsifiable Granule
- EO** : Emulsion Water in Oil
- EW** : Emulsion Oil in Water (Concentrated)
- GR** : Granule
- ME** : Microemulsion
- OF** : Oil miscible Flowable Concentrate (oil miscible suspension)
- SC** : Suspension Concentrate (Flowables)
- SE** : Suspo-emulsion
- SL** : Soluble Concentrate
- SG** : Water Soluble Granules
- SP** : Water Soluble Powder
- WG** : Water Dispersible Granules
- WP** : Wettable Powder

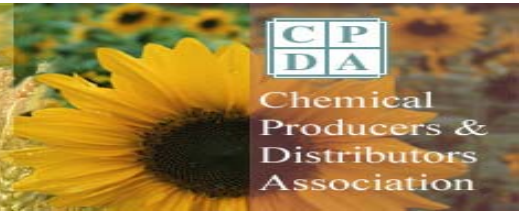
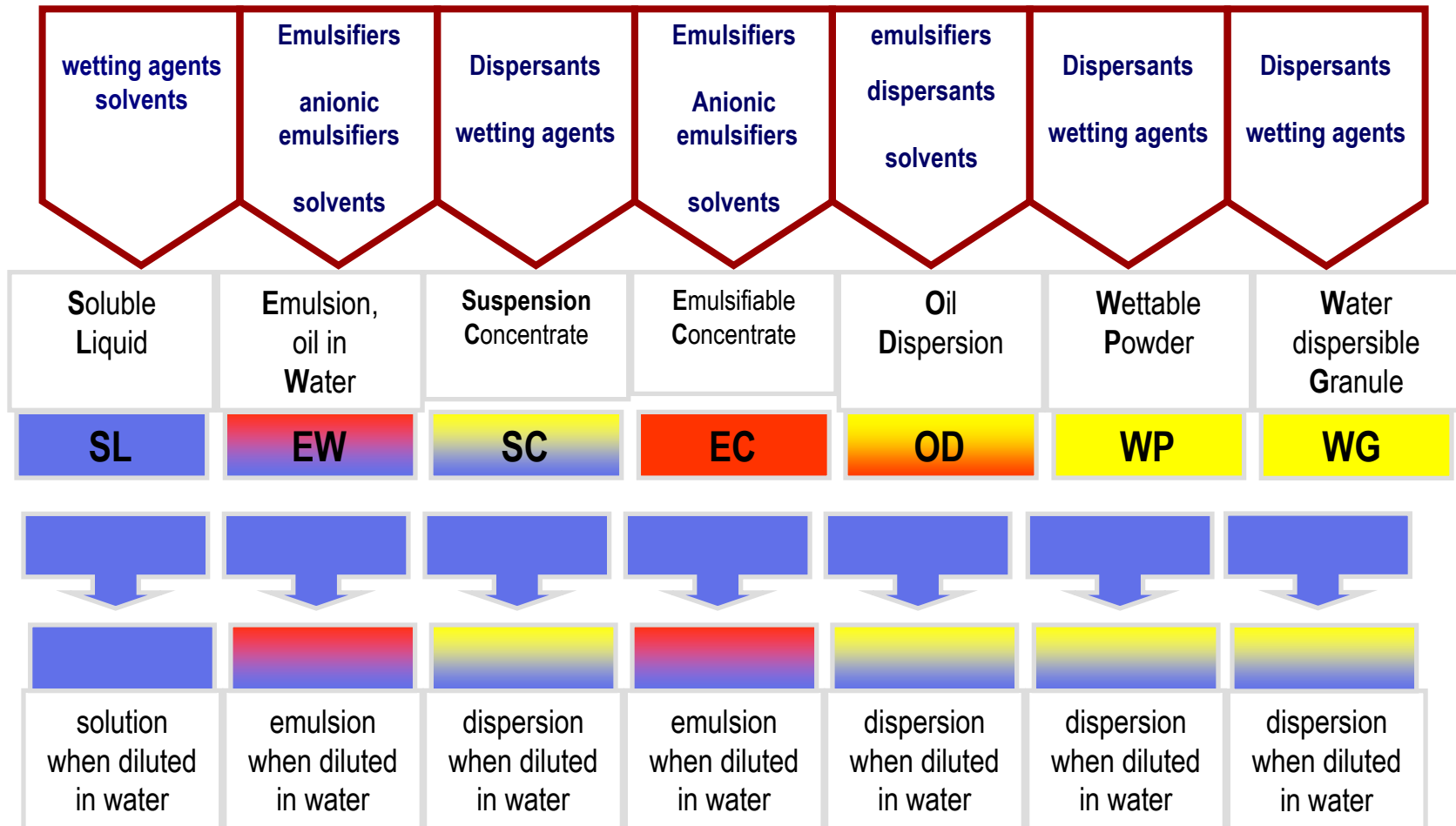
*CIPAC(Collaborative International Pesticides Analytical Council) Handbook Appendix D



CIPAC Nomenclature Defined

- CS : A stable suspension of capsules in a fluid (normally intended for dilution with water before use)
- EC : A liquid, homogeneous formulation to be applied as an emulsion after dilution in water
- SC : A stable suspension of A.I.(s) in a fluid intended for dilution with water before use
- SL : A liquid, homogeneous formulation to be applied as a true solution of the A.I. after dilution in water
- WG : A formulation consisting of granules to be applied after disintegration and dispersion in water

Examples of Formulation Types



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Basic Inert Ingredients

- Solvents - used to solubilize the active ingredient
- Surfactants
- Utility products
 - Preservatives
 - Antifreeze
 - Viscosity modifiers
 - Colorants
 - Emetics
 - etc



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Surfactant Basics

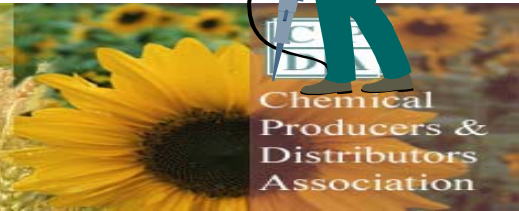
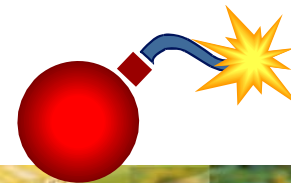


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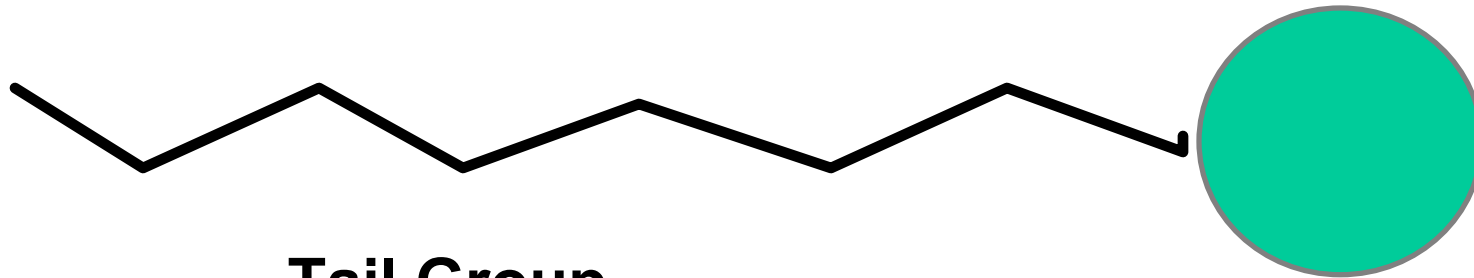
What Is a Surfactant?

SURFace ACTive AgeNT

- a substance which
 - migrates to surfaces or interfaces
 - lowers surface energy
 - reduces amount of work required to expand interfaces.



A Surfactant Molecule



Tail Group

(Hydrophobic or Lipophilic)

called **Hydrophobe** or **Initiator**

Alkylphenol

Fatty Alcohol

Fatty Amine

Propylene Oxide (PO) chain

Linear Alkylbenzene

Head Group

(Hydrophilic or
Lipophobic)

Ethylene Oxide (EO) chain

Sulf(on)ate



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What Do Surfactants Do?

- Improve wetting of surfaces
- Reduce surface tension
- Allow oil to be emulsified in water
- Keep pigments dispersed
- Provide cleaning
- Act as lubricants
- Prevent static cling
- Make hair shiny



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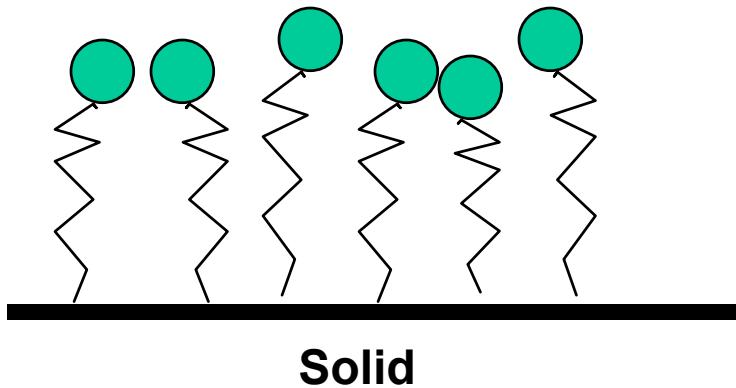
How Do Surfactants Work?

- Two most important actions
 - Adsorb at surfaces / interfaces
 - Form micelles

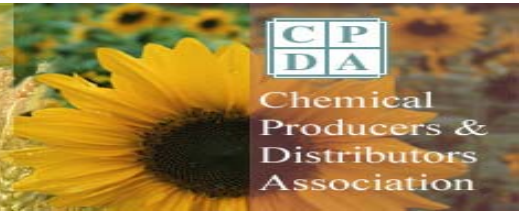
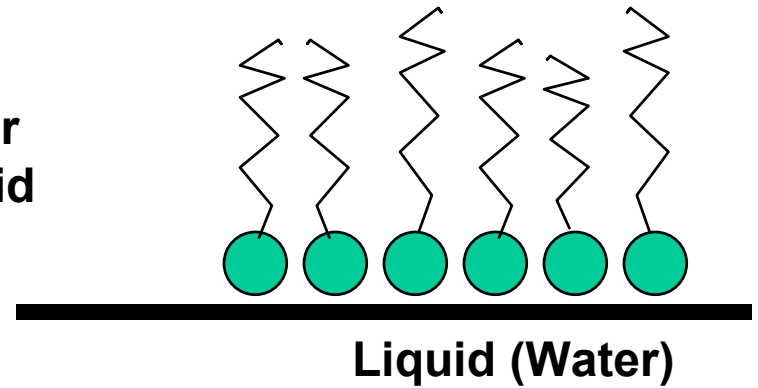


Adsorption

- Concentrate at surfaces or interfaces.
- Displace other fluids or gases at interfaces.
- Examples:
 - wetting, solid-liquid dispersion, detergency, lubrication



**Air or
Liquid**

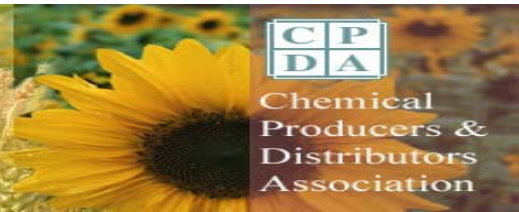
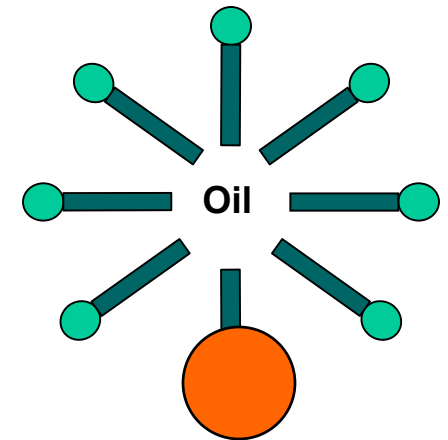


**CP
DA**

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Micelle Formation

- Concentrate at surfaces or interfaces.
- Aggregation of many surfactant molecules in some orderly form.
- Allow oils to be emulsified or solubilized in water.
- Surfactant-coated oil droplets



Inert Ingredients
in
AGRO
FORMULATIONS



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Typical Formulation of SL

- Active Ingredient
- Water
- Utility inerts



Typical Formulation of SL

- Active Ingredient
 - Must be completely soluble in water
- Water
- Utility inerts



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Typical Formulation of SL

- Active Ingredient
- Water
 - Free of sediment
 - Low electrolyte content preferred
- Utility inerts



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Typical Formulation of SL

- Active Ingredient
- Water
- Utility inerts
 - Surfactants for wetting, spreading
 - Tallowamine ethoxylates
 - Ethoxylated nonionics
 - EO/PO co-block polymers
 - Sequestrants
 - Crystal inhibitors



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Typical Formulation of EC

- Active Ingredient
- Solvent
- Emulsifier



Typical Formulation of EC

- Active Ingredient
 - Must be completely soluble in the solvent of choice
 - Must not degrade in the solvent
- Solvent
- Emulsifier



Typical Formulation of EC

- Active Ingredient
- Solvent
 - Most common solvent is Aromatic materials from C9 to C12
 - Other solvents can include:
 - Fatty acid derivatives (esters, amides, etc.)
 - Paraffinic solvents (linear, branched and cyclic)
 - Fuel based (e.g. kerosene)
 - Ketones
 - Carbonates
- Emulsifier



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Typical Formulation of EC

- Active Ingredient
- Solvent
- Emulsifier
 - Anionic surfactants
 - Calcium salts of Dodecylbenzenesulfonic acid (DDBSA)
 - Limited amine salts of DDBSA
 - Phosphate esters of nonionics
 - Nonionic surfactants
 - Ethoxylated nonionics (castor oil, fatty alcohols, fatty acids, alkylphenol, sorbitan ester)
 - EO/PO co-block polymers
 - Alkoxylated nonionics (contain hydrophobe other than EO or PO)



Typical Formulation of SC

- Active Ingredient
- Water
- Dispersant
- Wetting Agent
- Co-stabilizer
- Utility formulants



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Typical Formulation of SC

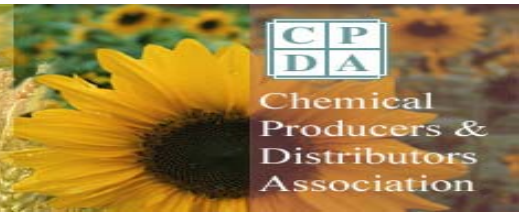
- Active Ingredient
 - Must be COMPLETELY insoluble in the water
 - Must be able to be milled (wet or dry) with no melting occurrence
 - Heavier (denser) materials are very difficult to handle in this formulation type
- Water
- Dispersant
- Wetting Agent
- Co-stabilizer
- Utility formulants



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Typical Formulation of SC

- Active Ingredient
- Water
 - Must be free of sediment
 - Lower electrolyte content is desirable
- Dispersant
- Wetting Agent
- Co-stabilizer
- Utility formulants



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Typical Formulation of SC

- Active Ingredient
- Water
- Dispersant
 - Naphthalene sulfonates (condensed and non-condensed)
 - Polymeric dispersants
 - Acrylic acid based
 - polycarboxylates
 - Some anionic surfactants can act as dispersants as well as wetting agents
- Wetting Agent
- Co-stabilizer
- Utility formulants



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Typical Formulation of SC

- Active Ingredient
- Water
- Dispersant
- Wetting Agent
 - Ethoxylated nonionics based on (fatty alcohols, alkylphenols, Akylpolysaccarides)
 - Anionic surfactants
 - DDBSA sodium salts
 - Sulfosuccinates
 - Alpha olefin sulfonates
 - Alkyl sulfates
 - Alcohol ether sulfates
- Co-stabilizer
- Utility formulants



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Typical Formulation of SC

- Active Ingredient
- Water
- Dispersant
- Wetting Agent
- Co-stabilizer
 - EO/PO co-block polymers
 - Alkoxylated nonionics (contain hydrophobe other than EO or PO)
 - Antisettling agent (e.g. clays)
- Utility formulants



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Typical Formulation of SC

- Active Ingredient
- Water
- Dispersant
- Wetting Agent
- Co-stabilizer
- Utility formulants
 - Viscosity modifiers (gums, clays and polymers)
 - Antifreeze (glycols)
 - Defoamers/Antifoams



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Typical Formulation of WG

- Active Ingredient
- Dry carrier (if needed depending on loading)
- Dispersant
- Wetting Agent



Typical Formulation of WG

- Active Ingredient
 - Must be insoluble in the water and not a humectant
 - Must be able to be dry milled with no melting occurrence
- Dry carrier (if needed depending on loading)
- Dispersant
- Wetting Agent



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Typical Formulation of WG

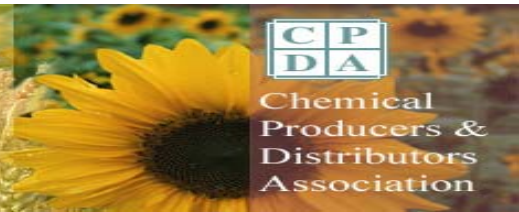
- Active Ingredient
- Dry carrier (if needed depending on loading)
 - Common carriers include (clays, silicas, biomaterials, etc)
 - Not needed if the label is greater than 90% active
- Dispersant
- Wetting Agent



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Typical Formulation of WG

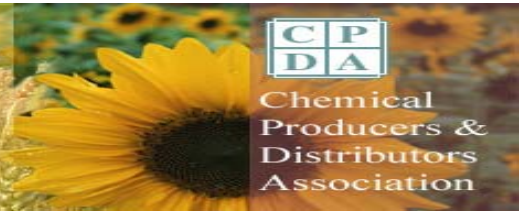
- Active Ingredient
- Dry carrier (if needed depending on loading)
- Dispersant
 - Naphthalene sulfonates (condensed and non-condensed)
 - Polymeric dispersants
 - Acrylic acid based
 - Polycarboxylates
 - Some anionic surfactants can act as dispersants as well as wetting agents
- Wetting Agent



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Typical Formulation of WG

- Active Ingredient
- Dry carrier (if needed depending on loading) Dispersant
- Wetting Agent
 - Generally dry materials are preferred
 - Anionic surfactants
 - DDBSA sodium salts
 - Sulfosuccinates
 - Alpha olefin sulfonates
 - Alkyl sulfates
 - Alcohol ether sulfates
 - Nonionic surfactants can be used
 - Generally are high Mwt solids
 - Can be absorbed on carrier to facilitate granulation
 - Low levels if the liquid holding capacity is high enough



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Typical Formulation of GR

- Active Ingredient
 - Must be COMPLETELY insoluble in the water and not a humectant
 - Must be able to be dry milled with no melting occurrence
- Dry carrier (if needed depending on loading)
 - Common carriers include (clays, silicas, biomaterials, etc)
- Surfactant (if needed for release)



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Some quick thoughts on less common formulations

- SE (Suspoemulsions) are combinations of EC and SC components
- CS (Capsule Suspensions) are SC formulations with the encapsulates acting as the particles to be suspended
- OF (Oil flowables) are actives suspended in oil but have unique problems due to the suspension of the active ingredient in the oil rather than the water and relatively few inerts have been found to be good dispersants in oil



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Some final thoughts....

- Formulants (inert ingredients) are increasingly being challenged to minimize the amount necessary in the formulation
- Some are trying to incorporate tank mix adjuvant functionalities into the packaged pest control product
- New formulation types are always being investigated to develop new and novel ways to enhance the efficacy and reduce the environmental footprint of the pest control products.



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