

## National Pesticide Applicator Certification Core Manual



**CHAPTER 4** 

## Pesticide Formulations

#### This module will help you:

- Recognize formulation abbreviations
- Identify formulation advantages and disadvantages
- Understand role of adjuvants





## **Important Definitions**

- Active Ingredient (Ai) the actual chemical in the product mixture that controls the pest
- Inert Ingredient other materials added with the AI when the product is formulated
- Phytotoxicity plant damage
- Adjuvant product added to spray tank to assist pesticide in its application

#### **Pesticide Formulation**

active ingredient (Ai) each Ai will be listed

+

#### inert ingredients

water, emulsifiers
solvents, dry carrier material
stabilizers, dye
surfactants: spreaders, stickers
wetting agents



#### **Brand Name Abbreviations**

Often brand names include abbreviations that describe something about the formulation

D – dust WSP – water soluble packet

G – granular ULV – ultra low volume

SP – soluble powder RTU – ready to use

S – solution GL – gel

WP – wettable powder LO – low odor

EC – emulsifiable concentrate

DF - dry flowable

WDG – water dispersible granule

## Pesticide Spray Batch

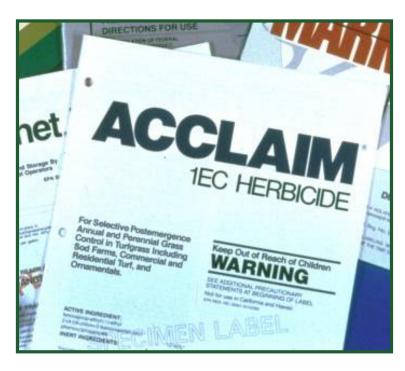
Pesticide Formulation

+

Water or oil

Spray additives=Adjuvants

### Deciphering the Ai Code in Product Names



1 lb Ai/gallon emulsifiable concentrate

**80SP** 

80% active ingredient by weight Soluble Powder

**40DF** 

40 % active ingred.

Dry Flowable

#### **Product Formulations**

Active and Inert Ingredients



- Active Ingredient
- Metribuzin (4-amino-6-1-1 dimethlyethly-

3-methythio 1,2,4,triazine 5 4H-one)

25%

Inert Ingredients

75%

- TOTAL 100%
- EPA Reg. No. 12333-344

	Lexone DF	ON
•	Active Ingredient: Metribuzin	25%
•	Inert Ingredients	75%
•	TOTAL	100%

	Lexone 2E	Juid
• Activ	e Ingredient: Metribuzin*	25%
• Inert	Ingredients	75%
• TOT/	<b>AL</b>	100%
• * cor	ntains 2 lbs metribuzin per gallon	

## Why Add Inert Ingredients?

- 1. For ease of pesticide product handling
- 2. Inerts make measuring and mixing pesticides easier
- 3. To provide for safety
- 4. Makes the Ai work better
  - Better penetration
  - More selectivity
  - Increased effectiveness



## Adjuvant

The term adjuvant basically means

additive (you need to memorize it)

- Formulation additive
- Additive which is sold separately to mix with the product when tank mixing
- Labels will often recommend to add an adjuvant
- Include surfactants, spreaders, wetting agents, colorant dyes, buffers, antifoaming agents, safeners, etc.

## Selecting a Formulation

- Evaluate advantages and disadvantages
- Do you have the right application equipment?
- Can the formulation be applied when and where it is needed?
- Will the formulation reach the target pest and be there long enough?

## **Spray Mix Terminology**

solution

suspension

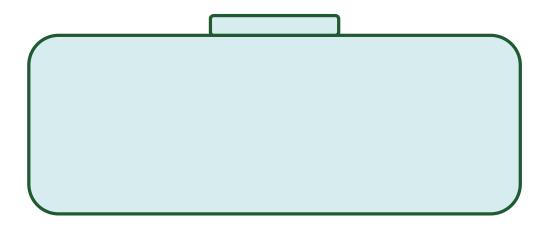
emulsion

How does it really mix in the spray tank?

#### Solution

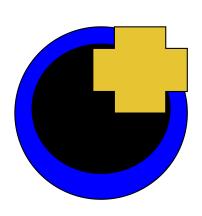
# Active Ingredient Either liquid or dry substance TRULY dissolves in water

just like sugar or whiskey in water \*usually transparent\*



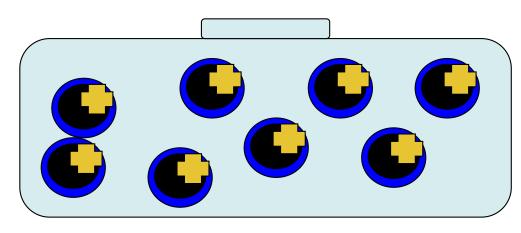
## Suspension

Solid particles suspended in a liquid like hot chocolate



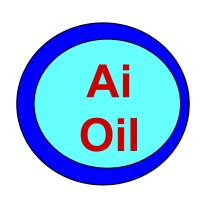
Active Ingredient (high %) impregnated onto Dry Carrier and mixed with an Emulsifier (slick, soapy)

agitation

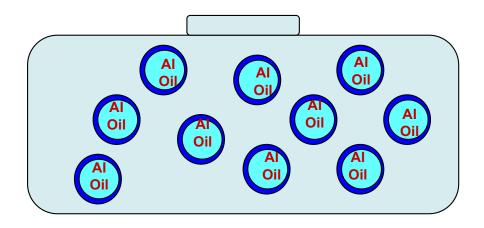


#### **Emulsion**

One liquid dispersed within another liquid like milk



Ai is dissolved in oil (oil/ai droplet) and mixed with an emulsifier Ai/Oil mixture is suspended in water forming a white emulsion



#### **Emulsifiable Concentrate (E or EC)**

Active ingredient (liquid) dissolved in a petroleumbased solvent with an emulsifier added

product



Turns white when mixed

Smells of solvents

diluted



## Emulsifiable Concentrate (E or EC) High Ai%

#### **ADVANTAGES**

- Easy to handle
- Little agitation
- Relatively easy on equipment
- Leaves little residue

#### **DISADVANTAGES**

- Phytotoxic plant injury
- Easily absorbed by the skin
- Flammable
- Deterioration of rubber and plastic hoses

# Liquid Formulations Solutions (S)

Ai dissolves in liquid carrier; once mixed with water, solutions do not settle out

product

diluted



Solutions (S)

#### **ADVANTAGES**

- Easy to handle
- No agitation
- Easy on equipment
- No residue
- Used indoors/outdoors

#### DISADVANTAGES

None

## Ready-to-Use Low Concentrate Solutions (RTU)



Easy and relatively safe to handle

Less than 1% per unit volume of active ingredient; high cost

**Ultra-Low Volume (ULV)** 

- Special-purpose formulation
- Almost 100% active ingredient
- Agriculture, forestry, mosquito control



#### **Ultra-Low Volume (ULV)**

#### <u>ADVANTAGES</u>

- Easy to handle
- Little or no agitation
- Easy on equipment
- No residue
- Used indoors/outdoors

#### DISADVANTAGES

- High drift hazard
- Specialized equipment needed
- Solvent wear on rubber and plastic
- Calibration critical

#### **Invert Emulsions**

- Oil carrier with water-soluble pesticide – consistency of mayonnaise
- Reduce drift and runoff
- Sticker-spreader
- Specialty uses: Rights-ofway and near sensitive areas



#### Aerosols (A)



- Some are ready-to-use
- Little active ingredient
- High drift potential
- Some require highly specialized equipment
- Difficult to confine
- Respiratory protection needed



Baits (B)

A bait is an example of a dry or liquid product that is applied without mixing





## Dry or Solid Formulations

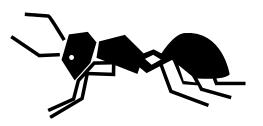
Baits (B)

#### **ADVANTAGES**

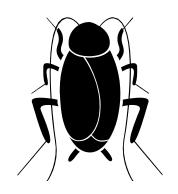
- Ready to use
- Coverage not critical
- Control pest that move in and out of area

#### DISADVANTAGES

- Attractive to children
- May kill domestic animals and wildlife
- Dead pest odors
- Old bait may serve as food source if inactive



Pastes (P), Gels (GL)



A bait formulated as a paste or gel that is applied with a syringe or bait gun

- Odorless
- Minimal exposure
- Easy to place
- Melt at high temperatures
- May stain porous surfaces
- Repeat application can create unsightly buildup

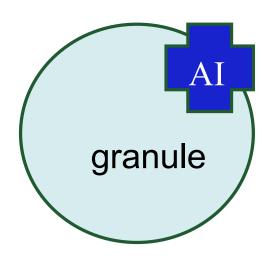


## **Dry or Solid Formulations**

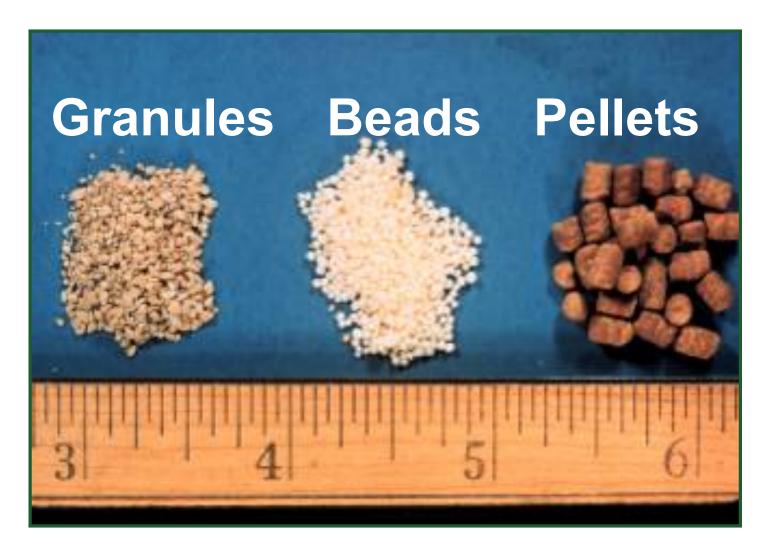
**Dusts (D) and Granules (G)** 

- Ready-to-use
- Can reach hard to get places
- Very little active ingredient
- Very fine, dry inert carrier
- High drift potential
- Distribution and calibration a problem
- Dusts: Irritating to eyes, nose, throat, skin





Granules (G) and Pellets (P or PS)



Granules: can be mistaken for food/feed

## **Dry Formulations + Water**

- ❖ Buy Dry --> Mix with water -> Spray
- Wettable Powders (WP)
- Water Dispersible Granules (WDG)
- Dry Flowables (DF)



# **Dry Formulations**Wettable Powders (WP or W)

Wettable powders settle out quickly, therefore require constant agitation in the spray tank

product diluted



#### Wettable Powders – high Ai %

#### <u>ADVANTAGES</u>

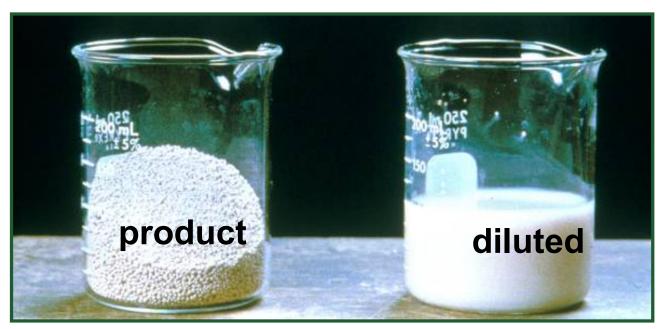
- Easy to store
- Easy to measure/mix
- Relatively less harmful to plants, animals and surfaces than ECs
- Less absorption by human skin and eyes

#### DISADVANTAGES

- Inhalation hazard
- Constant agitation
- Difficult to mix in hard water
- Abrasive to pumps and nozzles
- Visible residues

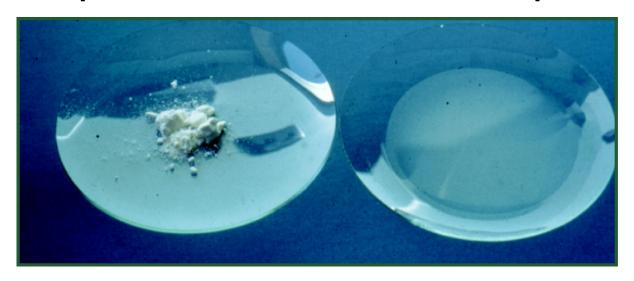
### Water-dispersible Granules (WDG) or Dry Flowables (DF)

These materials possess some of the same characteristics as wettable powders except they are formulated into granular-sized particles, so are easier to handle with little inhalation hazard



#### Soluble Powders (SP or WSP)

- Forms true solution, like sugar no agitation
- ❖ Ai is 15-95% by weight
- Few pesticides are soluble powders



#### Soluble Powders – high Ai %

#### **ADVANTAGES**

- Easy to measure/mix
- Form true solution
- Little phytotoxicity concern
- Less absorption by human skin and eyes

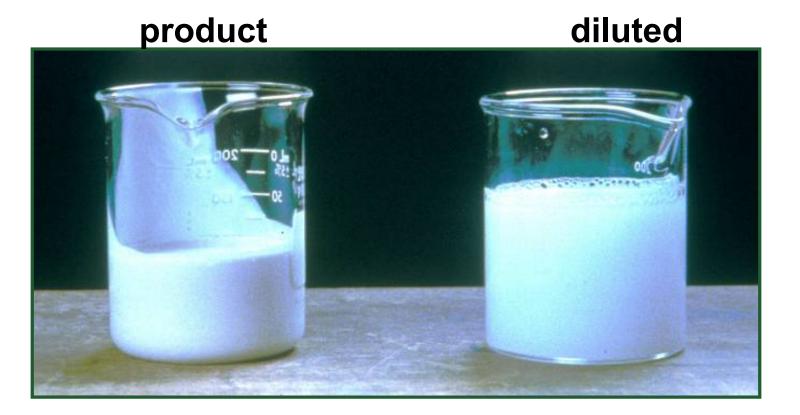
#### **DISADVANTAGES**

Inhalation hazard

Backto liquid foi a minute a m

# **Liquid Formulations**Flowables (F) or Liquids (L)

Flowables are basically a wettable powder pre-mixed with a liquid carrier



## Other Formulations

- Microencapsulated
  - High toxicity Ai in encased formulation

#### PENNCAP-M®

MICROENCAPSULATED INSECTICIDE

#### RESTRICTED USE PESTICIDE

Due to residual effects to avian species and hazard to bees.

For retail sale to and use only by certified applicators or persons under their direct supervision and only for those uses covered by the certified applicator's certification.

- Water-soluble packets
  - No human exposure when mixing



# **Other Formulations**

- Attractants/Repellents
- Impregnates
- Pesticide/Fertilizer
  Combination
- Animal Systemics





# Other Formulations Fumigants

- Active as a poisonous gas, penetrates cracks, crevices, and stored commodities
- Highly toxic to all living organisms
- Very high risk of inhalation exposure
- Specialized protection equipment; enclosed space



### **Pesticide Mixtures**

- Tank mixing multiple products is legal <u>unless</u> prohibited by the label
- Manufacturer only warranties their product alone or product mixtures listed on the label
- Manufacture notes known incompatibilities on label
- Incompatibility
  - Heat, clumping, precipitate
  - Inactivity of active ingredients
  - Increased phytotoxicity
  - Use Jar-Test to test for incompatibility
  - Field incompatibility can still occur

# Adjuvants

purchased additives to add to tank mix or added during formulation process

### Surfactants - group

- Wetting agents
- Spreaders
- Emulsifiers





#### **Others**





- Compatibility agents
- Defoaming agents
- Colorants/dyes
- Safeners
- Thickeners



# Adjuvants

## How to choose the right one?

- Read the pesticide label for recommendations
  - Some may prohibit use of an adjuvant
- Don't use industrial products or household detergents
- Test before you spend \$\$
- Remember, many pesticide products contain an adjuvant



# **Formulation Summary**

- Active and inert ingredients
- Dry and liquid formulations
- Adjuvants
- Choose a pesticide formulation that will best suit your pest problem and target site



# **Formulation Summary**

- Choose a pesticide formulation that will best suit your pest problem and target site
  - Safety, ease of use
  - Human exposure concerns
  - Phytotoxicity; visible residues
  - Application equipment considerations



Q1. Which of the following formulations typically has the lowest rate of active ingredient?

- A. Dusts (D)
- B. Wettable Powders (WP)
- C. Emulsifiable Concentrate (EC)
- D. Soluble Powder (SP)



- Q2. Which type of nozzle would pose a concern when using soluble powder formulations?
  - 1. no nozzle type poses a concern
  - 2. brass nozzles
  - 3. aluminum nozzles
  - 4. nylon nozzles

A. 1 only

C. 2 and 4 only

B. 2 and 3 only

D. 3 and 4 only



## Q3. Which of the following are considered surfactant-type adjuvants?

- 1. spreaders
- 2. buffers
- 3. wetting agents
- 4. colorant dyes

A. 1 and 2 only

C. 2 and 3 only

B. 1 and 3 only D. 3 and 4 only



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**FXTENSION** 

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