FORMULTAION OF PESTICIDES

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In formulating a pesticide, important factors that need to be considered include:

- Chemical properties of the active ingredient
- Physical properties of the active ingredient
- Inert materials
- Type of application equipment
- Nature of the tar get surfaces
- Marketing and transport aspects of pesticide usage

We must know the properties of the toxicant which includes:

- Melting point
- Boiling point
- Rate of hydrolysis
- Specific gravity
- Solubility
- Vapor pressure
- Ultraviolet degradation
- Inherent biological activity

DRY	LIQUID	OTHER
Dusts Granular Wettable Powder Soluble Powder Pellets Feed formulations Baits Fertilizer Combinations Water Dispersable Granule (WDG) Dry Flowable (DF)	Emulsifiable Concentrates (ECs) Ultra Low Volume (ULV) Tech Concentrates Flowables MECs Aerosols Liquified gas/Fumigants Solutions Paints	Controlled Release Repellents Attractants Collars & tags Impregnated products Predator control devices Animal Systemics (oral, dermal,injectable, implant, feed additive)

We must also know the inert ingredient regarding:

- Compatibility with active ingredient
- Compatibility with container
- Physical properties of the ultimate mixture

Finally, the formulation itself must be evaluated to learn the

- Homogeneity of the mixture
- Particle size
- Storage stability
- Retention by the target
- Wetting
- Penetration
- Translocation in plants
- Residual nature on a target or in the soil
- Nature of deposit
- Efficacy
- Hazard to user

TYPES OF FORMULATION

DUST

- Dusts usually contain two ingredients, an inert diluent and the toxicant.
- The inert ingredients of dusts must be relatively non-adsorptive to avoid inactivating the pesticides.
- They must be finely ground for ease of application and good coverage.
- Dusts are the least effective and the least economical of the pesticide formulations because dusts tend to drift during application, resulting in a poor deposit to target surfaces.

- Dusts are usually safer than liquid formulations.
- Pesticides applied as dusts compared to those applied as suspensions or emulsions has short residual life.
- Dusts are formulated as dust concentrates which contain 25, 50, or even 90% toxicant.
- They can be diluted with cheap local diluents by a simple process of mixing or blending before application.
- Currently, dusts are not much used, because of their drift potential and inhalation hazard, and because of improvements in the other types of formulations.

Wettable Powders

- WP is the most widely used agricultural formulation.
- It consists of the toxicant, inert diluent, and a wetting agent.
- The inert diluent is usually an adsorptive clay such as atta pulgite. The wetting agent may be a blend of two or more surfactants.
- The toxicant usually comprises from 25% to 75% of the mixture. method of preparation is to mix the clay with a solution containing the toxicant (if solid), then allowing the solvent to evaporate.

- WPs are sometimes prepared by the direct grinding of crystalline toxicant along with diluent.
- The objective in any case is to prepare a homogenous mixture that can be ground to a fine powder.
- As the name implies, WPs are designed to be mixed with water and applied as a spray.
- These are relatively safe on foliage (no phytotoxicity), but the spray mix requires constant mixing.

Emulsifiable Concentrates

- This type of formulation is also designed to be applied as a spray by mixing with water to form an emulsion.
- An emulsifiable concentrate consists of the toxicant, a solvent for the toxicant, and the emulsifier (surfactant).
- The toxicant content of ECs is expressed in terms of weight/volume rather than as weight/weight as with the WP.
- Thus, ECs may contain 2 to 4 lb of toxicant per gallon, approximately equivalent to 25% to 50% by weight.

- ECs are usually more easily absorbed by skin than WPs and dusts, and are thus more hazardous if spilled on the applicator.

- Sensitive plants are more apt to be damaged by this formulation than by WPs because the solvent may increase penetration into the plant.

- On the other hand, the lack of masking by diluent probably increases the effectiveness of ECs over WPs

Suspendable Concentrates

- These pesticides can be formulated to become water-based mixtures that can be handled and applied in the same manner as ECs.

- Suspendable concentrate formulations contain 50% to 90% of the toxicant that remain in suspension for long periods.

- Suspendability and storage stability are improved by inclusion of surfactants and various additives.

Water-soluble Powders

- Insecticides used in water-soluble formulations easily dissolves in water.
- In formulation, the technical grade material is a finely ground solid.
- It can be added to the spray tank, where it dissolves quickly.
- Once dissolved, an SP becomes an invisible solution that can be applied to approved surfaces without constant agitation.
- The most common SPs used in pest control are Acephate Turf and Acephate PCO Pro (Orthene) concentrates.

Solutions

- A solution formulation is the true solution containing the toxicant and solvent, which can be used directly without further dilution.
- Solutions can be used for household insect sprays, roadside weed eradication, and rangeland spraying, whenever phytotoxicity is not a problem.
- Solutions do not contain surfactants, because the solvent wets the target readily.
- Instead, such compounds are dissolved in a water-miscible solvent to avoid hydrolysis and then mixed with water before application. Examples of such formulations are Azodrin WMC and Lannate WMC.

Granules

- A granular formulation is basically the same as a dust formulation.
- It contains toxicant (1%-10%) and an inert diluent. Granular particles can be prepared in several ways.
- Granules are mostly used for application to soil and water.
- They are useful in variety of insect control situations.

- Examples include application to the seed bed for seed protection, broadcasting and tilling into the soil for soil insect control, application to growing crops for either foliar or soil insect control and application to ponds for mosquito control.

- They are easy to apply and are not as likely to drift as dusts or spray.

- They have less tendency to adhere to foliage and can thus be applied to soil surface through a canopy of leaves.

Water-dispersible Granules

- A water-dispersible granule formulation contains typically a toxicant (50%-95%, w/w), dispersant, binder, and diluent.
- This formulation, also known as dry flowable, is intended for application after disintegration and dispersion in water by conventional spraying equipment.
- WGs are easier to use than WPs, because they have low-dust properties (due to larger particles) and exhibit good flowability.

Ultra-Low Volume Formulations

- ULV formulations are usually the undiluted technical-grade material or the original product dissolved in a minimum of solvent.
- It is useful for the control of public health, agricultural, and forest pests.
- This technique is useful in treating large areas.
- Another advantage of ULV is the greater effectiveness of the toxicant, possibly because there are no inert ingredients, or surfactants to mask the toxicant.

Aerosols

- Aerosols are commonly used for controlling resident flying and crawling insects such as mosquitoes and cockroaches.

- In principle, the active ingredient is dissolved in a volatile, petroleum solvent and the resulting solution is atomized through a jet by means of a pro pellant.

- The propellant can be a gas under pressure or a liquid that is gaseous at atmospheric pressure.

- Chlorofluorocarbon used to be employed as a propellant, but has been replaced for environment reasons with other volatile liquids.

Controlled Release Formulations

- It is a recent innovation in which the pesticide is incorporated into a carrier, generally a polymeric material.
- The rate of release of the pesticide is determined by the properties of the polymer itself as well as environmental factors.
- There are mainly two types of CR formulations: reservoir devices and monolithic devices.
- In the monolithic device, the toxicant is uniformly dissolved or dispersed within the polymer matrix to become micro-particles or strips.