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Agrochemical Formulation: An Overview

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SUMMARY

This article is related to the different agrochemical formulations like insecticides, herbicides, fungicides and nematicides. It may also include synthetic fertilizers, hormones and other chemical growth agents, and concentrated stores of raw animal manures. Different types of agrochemical formulations i.e. in the solid, liquid and gas formulations. Their benefits and disadvantages are mentioned in this article.

INTRODUCTION

An agrochemical or agrochemical, a contraction of agricultural chemical, is a chemical product used in agriculture. In most cases, agrochemical refers to pesticides including insecticides, herbicides, fungicides and nematicides. It may also include synthetic fertilizers, hormones and other chemical growth agents, and concentrated stores of raw animal manures. A Pesticide formulation is a combination of active and inert ingredients that forms an end-use pesticide product. Pesticides are formulated to make them safer or easier to use. This is because many pesticide active ingredients, in ‘’pure’’ (technical grade) from, are not suitable for application. In their concentrated from, some are extremely toxic, many do not mix well with water, some are unstable, and some are difficult (or unsafe) to handle, transport, or store. To address this problem, manufacturers add inert ingredients to end-use pesticide products. Inert ingredients have no pesticide activity, and some simply serve as diluents or carriers. In many case, inert ingredients make the formulated product safer, so, in addition to the active ingredient intended to control the target pest.

A Formulated product may consist of:

- A carrier or diluent, such as an organic solvent of mineral clay.
- Surface-active ingredients, such as stickers and spreaders.
- Other additives, such as a stabilizers, dyes, and chemicals, which make the product safer or enhance pesticide activity.

What is pesticide formulation?

A homogeneous mixture and stable mixture of active and inert ingredients which make the final product simpler, safer and more officious apply to a target pest.

Type of agrochemical formulations:

SOLID	LIQUID	GAS
Dust	Emulsifiable Concentrate	Aerosol
Dry Flowable	Flowable	Fume
Granule	Soluble Liquids	Smoke
Pellet	Micro capsulated	---------
Soluble Powder	Suspension Concentrate	---------
Water Dispersible Granule	Emulsion in Water	---------

Why Formulation?

Most of the technical pesticide cannot be applied directly since they may be needed in extremely small quantities and are highly toxic. They must be converted in to a product which upon application ensures even distribution of the active ingredients over target, storage stability, shelf life, safe delivery, target action and safeness non target.

Solid Formulation

1) Wettable Powder (WP) Formulation-

A WP is a powder formulation that forms a suspension when mixed with water prior to spraying. WP formulations consist of one or more active ingredients which are blended and mixed with inserts, diluents and surfactant. Wetting agents are used to facilitate the suspension of the particles in water.

Benefits

- Uniform distribution of active ingredients
- Exceptional residual control
- High loading of active ingredient is possible
- No storage sedimentation issues (due to be a powder)
- Reduced dermal hazards

Limitations

- High levels of dust can cause operator safety concerns during manufacture and application
- Difficult to mix in the spray tank

2) Water dispersible granules (WDG)

WDGs are a solid, non-dusty granular formulation which disperses or dissolves quickly when added to water in the spray tank to give a fine particle suspension. They provide a system for delivering solid active ingredients to a target organism. They allow producing highly-concentrated formulations which are wettable and easily disintegrated on contact with water. WDG's are an attractive alternative to wettable powder (WP) formulations due to their reduction in dust production.

Benefits

- Non-dusty so reduces inhalation hazard
- High loading of active ingredient is possible (up to 90%)
- No crystal growth or sedimentation
- Package disposal easier to deal with than for liquid formulations

Limitations

- Granule disintegration suspensibility upon dilution
- Low melting point active ingredients can be problematic
- High processing cost
- Difficult to include bio enhancing adjuvants in the recipe

3) Dust

Most dust formulations are ready to use and contain a low percentage of active ingredients (usually 10 percent or less by weight), plus a very fine, dry inert carrier made from talc, chalk, clay, nut hulls, or volcanic ash. The size of individual dust particles varies. A few dust formulations are concentrates and contain a high percentage of active ingredients. These concentrates are mixed with dry inert carriers before applying. Dusts are always used dry and can easily drift to non-target sites. They are widely used as seed treatments and sometimes for agricultural applications. In structures, dust formulations are used in cracks and crevices and for spot treatments to control insects such as cockroaches. Insects ingest poisonous dusts during grooming or absorb the dusts through their outer body covering. Dusts also are used to control lice, fleas, and other parasites on pets and livestock.

Advantages

- Most are ready to use, with no mixing
- Effective where moisture from a spray might cause damage
- Require simple equipment
- Effective in hard-to-reach indoor areas

Disadvantages

- Easily drift off target during application

- Residue easily moved off target by air movement or water
- May irritate eyes, nose, throat, and skin
- Will not stick to surfaces as well as liquids
- Dampness can cause clogging and lumping
- Difficult to get an even distribution of particles on surfaces

Liquid formulations

1) Emulsifiable Concentrate (EC)

ECs are still one of the most common formulation types for crop protection products worldwide. When EC formulations are diluted with water in the spray tank, they form a spontaneous emulsion, with emulsion droplets in the size range of 0.1 to 1.0µm. The spontaneous emulsion can be achieved by selecting one or more surfactants based upon their ability to emulsify the solvent system, including the active ingredient, into water. It is by means of balancing the water soluble and oil soluble surfactant components at the water/solvent interface that a physically stable emulsion is formed. When sprayed, the dilute emulsion gives a uniform and accurate application of active ingredient on the crop, which is essential for effective pest control.

Benefits

- Simple to manufacture
- Relatively high biological activity
- Good chemical stability

Limitations

- Solvents may affect plastics and rubbers in spray applicators
- Active ingredients need to be fully soluble in the solvent over a range of temperatures
- Use of water miscible solvents can cause active ingredient crystallization problems upon dilution

2) Suspension Concentrate (SC)

Suspension concentrate (SC) formulations are a solid active ingredient dispersed in water. SCs have grown in popularity due to benefits such as absence of dust, ease of use and effectiveness when compared to formulation types such as emulsifiable concentrate (EC) and wettable powder (WP) formulations. To formulate a stable SC, the active ingredient must remain insoluble under all temperature conditions.

Benefits

- Water based hence it provides good safety and user convenience
- Suitable for many active ingredients with low water solubility
- Absence of dust
- Absence of flammable liquids
- Small particle size of the active ingredient
- Adjuvants can be built-in for bio enhancement

Limitations

- Not compatible with water soluble active ingredients
- Crystal growth can be a problem if the active is partially soluble in water
- Long term stability issues

3) Soluble Liquids (SL)

Soluble Liquids are water soluble formulations of active ingredients in water or in polar solvents. The active ingredient must be chemically stable in water and in the selected solvents. The biological activity of SL is linked to the presence of a biological activator or wetter to improve the penetration of the active ingredient into the cuticular layer.

The general composition usually contains:

Active ingredient(s) :- 100 to 600 g/l

Surfactant	:-	50 to 200 g/l
Buffers, sequestering	:-	0 to 30 g/l
Water (and polar solvents)	:-	Up to 1000 ml

4) Micro-emulsions (ME)

MEs are water-based formulations with a very small emulsified droplet size; this makes the formulation transparent. They are thermodynamically stable over a wide temperature range due to this very fine droplet size, usually between 0.01 and 0.05 μm.

Benefits

- Thermodynamically stable therefore have increased shelf life
- Low solvent level
- Easy to transport and store
- High flash point and safe handling

Limitations

- Low active ingredient content
- Require high surfactant level to form

5) Oil Dispersion (OD)

An oil dispersion (OD) formulation is a solid active ingredient dispersed in oil. The oil can vary from paraffinic to aromatic solvent types and vegetable oil or methylated seed oils. Ideally the active ingredient is uniformly suspended in the oil phase. ODs have extended to other active ingredients due to their better spray retention, spreading and foliar uptake as the carrier oil often acts as an adjuvant.

Benefits

- The oil continuous phase acts as a built-in adjuvant
- The oil adjuvant can provide both penetration enhancement and spray retention enhancement
- Does not need preserving (water free)

Limitations

- Can suffer from more sedimentation compared to water based systems
- Difficult to formulation

CONCLUSION

Todays in agriculture ecosystems there is huge number agrochemicals presented in market. Agrochemical formulation which is needed for its better and protective use to farmers. Most of agrochemicals cannot apply directly to crop and it is highly toxic to human body. For their appropriate use the formulation is must importance. There are mainly three formulations solid, liquid and gasses. Among these all, mainly solid and liquid formulations available in market as compared with gasses formulation.

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