The Ideal Agricultural Formulation Or The Practical Compromise

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Today it is considered commonplace to take an impossible material, make an impossible mixture, dispense it at an impossible rate of application to do an impossible job and, I might add, sell it at an impossible price. It is further expected that you take herbicidal materials and accomplish the nearly impossible task of eliminating one type plant, leaving the adjacent plant untouched. Volatility may exist due to the chemical composition and being made from low molecular weight and low boiling point alcohols, such as methyl, ethyl, isopropyl, butyl or amyl. These materials will under high temperatures and humidity form dangerous and herbicidally active vapors. The use of low volatile alcohols of higher molecular weight and higher boiling points such as iso-octyl or 2-ethylhexyl will reduce this vapor effect, but will not improve careless spraying on desirable species.

Herbicidal materials are available in many forms. Wettable powders, emulsifiable concentrates, water and oil soluble amines, inverts, and granules.

In the case of wettable powders or water diluted mixtures, such as ester formulations, primary concern generally concentrates on the wetting and suspending agent and emulsifiers used. At this point a series of compromises start whereby the finished product is designed to function under a given set of conditions.

To begin with, the formulation may have to function at a high rate of dilution or low rate. The surfactants must disperse unlike materials in various solvents and/or in water of various degrees of hardness, pH and temperature. The final mixture, moreover, should not foam excessively which would make it difficult to pump and spray the diluted mixture.

Formulations should disperse spontaneously, and with moderate agitation—with a simple paddle. They must stay well dispersed until the mixture is sprayed—perhaps a time of two hours. Improvements of the mixing with pumps and bypass agitation does much to improve the condition.

Ideally the surfactants (wetting agents and emulsifiers) function to make the mixture homogeneous or uniform throughout the spraying period. They also function in themselves or with additional materials as wetting agents and as spreader stickers. This aids in penetration of the plant structure and minimizes burning or plant shock until the material has been absorbed and is ready to be translocated by the plant.

Once a material is made to have good "bloom" and stable emulsion characteristics, we have to be concerned about the shelf life, or "keeping quality." This must be taken into account because all the materials made in any given year may not be completely sold or some may remain to be used next year. We take this into consideration from the start and compensate by over-formulation for performance and storage stability. These are features you may sacrifice in bargain formulations.

Regulatory agencies have many warnings that must be stated on the label. We warn of the pitfalls if the material is not mixed well with the water or first added to at least half of the dilution water, adding the balance to mix effectively. This is to prevent the accidental formation of "Invert"—or water-in-oil emulsions. We also caution about dilution in cold water (50° or below from deep wells or springs) which may cause precipitates to form that are often difficult, if not impossible, to dissolve. Finally, we stress that you should not puncture the container, or vent excessively, because evaporation of solvents may occur from not resealing the container and result in concentration of the formulation.

The importance of quality emulsifiers and good agitation during mixing and spraying should be emphasized. The prime reason is to disperse a uniform spray composition from the start to the finish. Like a paint, if the material has been stored for any length of time, the entire contents of the original container should be well stirred or shaken before mixing to disperse and emulsifier, solvent and active ingredients.

Failure to mix well is a prime cause for many failures. Often a mixture at the start of spraying may be light on emulsifier content because of separation, and the behavior or spray results could be erratic. This happens since all the active ingredients could sink to the bottom and be dispersed first and result in a burn or overdose at the start of the spraying, and conversely no effect, or gradually reduced activity, as spraying progresses. Agitation of 6-lb-per-gallon formulations are more critical due to the lack of additives in the formulation.

The opposite can also happen where little or no active materials are sprayed out, and from appearance it looks like a beautiful emulsion, but no kill. Good mixing of the product before removal from the original container will solve this problem and is very important.

What we have been talking about are the fundamentals that we use to tailor-make a product so that it will do the best job under the most adverse conditions we can find.

Water soluble amine type formulations can be generalized as being alkyl or alkanol amine salts in water such as the dimethylamine salt of 2,4-D acid. They possess an odor very similar to ammonia and will tend to concentrate if left open in hot weather, losing some of the amine used to render the acid soluble. More costly amines can be used in their manufacture, and there is much to recommend their adoption. However, there is some buyer resistance to paying approximately a dollar more per gallon for an improved product even though it will not freeze or evaporate, will mix in any hardness of water and has no color

or odor, all of which are advantages. You alone, the users, will decide whether we make or sell a product of this type. These products fit into the overall spectrum of herbicides and find preferred use in many areas like pasture spraying or spraying where solvents might have an adverse effect in some over-seeded crops. In part of the country this Amine-D has found great use in the past in tree injection work for timber improvement, but due to high cost of hand labor, this practice is being changed.

Water hardness is a big factor in the effectiveness of amine formulations. Water with a high mineral content may "tie-up," or render insoluble, a large amount of herbicide acid which is precipitated into the form of a useless sludge.

For this reason we add very costly materials to certain formulations to protect against such behavior. These materials are called chelating agents. They could be termed our "insurance" to enable our products to perform under and in spite of all conditions. Here again bargain formulations can not afford these costly additions.

During the past several years, a new type of amine salt product has been developed, called a fatty amine or oil-soluble amine. These products can be made so that they are oil soluble and can be made water emulsifiable. They have many advantages for better absorption and penetration and tend to extend the critical time that effective spraying can be done. We have sprayed brush and trees in drainage ditches up to two weeks before a killing frost with this type of material and had excellent results, something that we have never been able to accomplish with other formulations.

The oil-soluble amine is more expensive to make because of higher material costs in manufacture. This formulation appears to absorb better and resist wash-off after spraying and therefore, is an improvement if rain occurs after spraying. Such products are unique in that they can be tailored to a final pH, that is adjusted to a desired acidity or alkalinity as they are being made. This is one phase of herbicidal activity that is just now being explored. Development work is being undertaken on the effect of pH and the so-called synergistic effect of different materials being added together, so that the activity appears to be more than the sum total you would normally expect from either material. Fertilizers, for example, very often seem to accelerate the uptake of herbicides.

I would like to add at this point a comment on the relative persistence of these materials after spraying. If, for example, a rain or irrigation occurs after spraying, some of the herbicide will be washed off the plant and down to the soil. It may be decomposed by sunlight and high temperatures very rapidly in a few days or may leach a little further into the soil and be decomposed in a little longer time by soil bacteria, or it may be taken up by another seedling or, we hope, undesirable plant and metabolized.

If on the other hand you were to get what we call a "gully washer" or a "frog strangler" type rain, this material will be carried into small ditches and streams and be further diluted and the same type of sunlight and bacterial decomposition should occur very rapidly. Minute quantities of phenoxy type herbicides in this extremely dilute form will serve more as a growth stimulant rather than a herbicide.

The "inverts" or thickened sprays are water-in-oil type emulsions. Upon mixing the water becomes surrounded by the oil phase, like a balloon, the material changes from clear to cloudy and then opaque with an accompanying thickening like mayonaise, which is an actual practical food form of an invert. At this point the material is said to be "inverted" or thickened and actually this "thickness" or high viscosity can be measured, controlled, and made to do a desirable job of spraying. The idea is to control drift and improve weed kill. Due to the nature of the emulsifiers used in this type product, they possess extreme wetting capability and will render materials such as insecticides, fertilizers or two different types of herbicides to be co-dispensed. With proper handling they are probably the greatest improvement yet made to ease the control of disperse spray handling so as to keep the spray confined to a given target area. New and improved equipment has been developed for this type of spraying, as has the quality of suitable invert formulations. Many new uses of this technique of application have been suggested and tried. The uses for this type of product application is as large as the user's imagination. Truly, we are in a miracle age where we are able to accomplish so much with the chemicals we have in time of great manpower shifts and shortages.

Another type of material is the granular formulation. Granular material generally is in the form of Attapulgite clay, which is extruded, dried, and sized through screening operations to classify it to a given mesh size of particles per square inch. In agriculture where it is desirable to cover a large area, it is more evenly distributed in form of finer mesh sizes using, for example, 24/48 mesh. If this same type of material is used in aquatic weed work, it will not wet readily, and may tend to agglomerate, or gather, and then practically have to be beaten into the water in order to wet the granules sufficiently to sink. The larger mesh material is more adaptable to rooted aquatic weeds, 15/30 mesh or in many cases the 8/15 mesh size would be more advantageous. Formulations could include materials that could wet them faster and or cause them to break-up rapidly. The opposite might be more desirable with a slower release, and retard the dissolving action so that they would absorb in place where lodged on the bottom. The materials that are used to impregnate the granule may be made fast or slow dissolving, for example, amine salts or esters of the same acid, or mixing acids like 2,4-D, 2,4,5-T, or Silvex. We are on the threshold of the adaption of herbicidal materials in more exacting prescriptions to cure a specific weed or brush problem. The desirable treatment to accomplish the greatest benefits from the application of these chemicals must be well documented. We could, however, stand some improvement communication-wise as to the desires of ultimate users as to specific needs.

Like all well organized, quality oriented companies, we do annual competitive product shopping. By purchasing directly from dealer's shelf we get an idea as to the quality of product our competitors are offering. We examine this material the same as we would ours, for in all likelihood our competitors as well as the State Plant Board and other regulatory agencies are doing the same thing regularly. By this method, on a continuing basis, we can monitor general quality and keep pace with new developments as they occur.

Many times we are asked by the Sales Department and our distributors why a certain product can be sold cheaper by someone else. We are constantly reviewing new chem-

icals, containers, and methods of handling to give the most to our customers for their dollars.

May I quote a specific example. We had been advised that a dimethylamine 2,4-D product was being offered cheaper than ours in a rather high volume area of consumption. I happened to be in a nearby area and made it a point to check this material and the reasons that such a material could be offered at this price.

Nearing the general area, I beamed in with my nose and found the operation was similar to one of our local Arkansas "moonshiner's" operations. The operation consisted of a gravity filling operation with a hose hooked up to a tank car of 6-lb. amine parked on a railroad spur. The equipment was an old platform scale that an old fellow used to fill the drums. Final dilution was made with a garden hose connected to a water hydrant. I wandered up to the operation, if you use the term loosely, and asked about a nearby town direction and then asked what the odd smell was. The man did not know what it was, so I asked him where the label was and he told me warily that a man hired him to fill it about here with tank car stuff (pointing to the outside of the drum) and about here with water, put the bung in and they would come get it later. The amounts indicated by his pointing finger would be about like the old boy's rabbit sausage, 50/50, one horse—one rabbit. It looked like it would be about a 3 lbs./gal. final mix, instead of a 4-lb. material as represented on the label. They were using reconditioned and some no-condition drums. I told him I'd like one for a trash burner. He gave me the name of the fellow that they got the drums from and pointing to his pile of drums he said, "Them kind is $2.00 and them cleaned ones in $3.50."—a far cry, I might add, from the $7-$7.50 that we pay for new drums. Thanking him for the information, I asked where I could get some of the finished stuff if I wanted it. He named a few places and I left. I visited one of the places he mentioned and asked for a sample to try, and composite sampled a few to get a rough idea as to the actual acid equivalent in the material. The analysis of these samples ranged from 3.42-3.6 pounds per gallon.

To sum this up, the customer got an average of 3.5 lbs per gallon of material in a drum that just might hold the product until he sprayed it, but he saved 5¢ a gallon on the price of 4-lb product. I guessed that the one-man plant would also function as a trouble shooter, under the old parachute guarantee, "If it don't open on the way down bring it back."

Seriously, however, the future of mankind lies in the improvements that are being made today in the area of weed control and brush control. Anything that can be done will be done with the cooperation of the users and the chemicals now available or which will be made available by industry.