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BUREAU OF ANIMAL INDUSTRY—Circular No. 89.

A. D. MELVIN, D. V. S., Chief of Bureau.

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SIR: Certain crude oil has been demonstrated to be very efficacious as an insecticide, but when used without dilution it is occasionally injurious to the treated animals. The accompanying paper describes a method for the emulsification of this oil by means of which a satisfactory dip containing any desired proportion of oil can be prepared. The value of the diluted oil in the treatment of stock diseases has not yet been definitely determined, but it seems advisable to call attention to the method of emulsification in order that those interested in this subject may have the opportunity of testing the diluted oil during the coming spring.

In view of the above facts I recommend that this manuscript be published as Circular No. 89 of the Bureau of Animal Industry.

Respectfully,

A. D. MELVIN,
Chief of Bureau.

Hon. JAMES WILSON,
Secretary of Agriculture.

THE PREPARATION OF EMULSIONS OF CRUDE PETROLEUM.

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FORMER METHODS.

Kerosene has long been recognized as a most efficient insecticide, but its irritating action, as well as the very considerable cost involved, has prevented the use of the pure oil as a local application in the various parasitic skin diseases of animals.

In order to overcome these objections various expedients have been resorted to, all of which had for their object the dilution or emulsification of the kerosene. Probably the best known and most generally employed method for accomplishing this result is that which is based upon the use of soap as an emulsifying agent. The formula which is used almost universally for making the kerosene soap emulsion is as follows:

Kerosene	2 gallons.
Water	1 gallon.
Hard soap	$\frac{1}{2}$ pound.

The soap is dissolved in the water with the aid of heat, and while this solution is still hot the kerosene is added and the whole agitated

vigorously. The smooth white mixture which is obtained in this way is diluted, before use, with sufficient water to make a total volume of 20 gallons, and is usually applied to the skin of animals or to trees or other plants by means of a spray pump. This method of application is used because the diluted emulsion separates quite rapidly, and some mechanical device, such as a self-mixing spray pump, is required to keep the oil in suspension.

It will be readily understood that this emulsion would not be well adapted either for use as a dip or for application by hand, for in the one case the oil, which rapidly rises to the surface, would adhere to the animals when they emerged from the dipping tank and the irritating effect would be scarcely less than that produced by the plain oil, and in the second case the same separation of the kerosene would take place and necessarily result in an uneven distribution of the oil on the bodies of the animals which were being treated.

CRUDE BEAUMONT OIL AND ITS EMULSION.

Within recent years it has been found by the Bureau of Animal Industry that a certain crude petroleum from the Beaumont oil fields is quite effective for destroying the Texas fever cattle ticks. This crude petroleum contains from 40 to 50 per cent of oils boiling below 300° C. and from 1 to 1.5 per cent of sulphur. Now, while this crude oil is an effective dip when properly applied, there are certain objections to its use—the cost of the oil when it is necessary to ship long distances, and the occasional injury to cattle which follows its use.

In order to overcome these objections and thereby permit the use of the oil in cases of cattle mange and sheep scab, as well as for destroying the Texas fever cattle ticks, experiments were undertaken looking to the preparation of an emulsion of the Beaumont crude oil for the uses just indicated.

As will be inferred, the reason for preparing an emulsion of Beaumont crude petroleum was to enable the Bureau to determine whether or not the diluted oil would prove to be as efficacious as the pure oil, for if an emulsion was found to be satisfactory the injurious effects which occasionally follow the use of the pure oil could probably be done away with, and, in addition, the cost attending the use of Beaumont oil would be greatly reduced.

There were two properties which seemed to be essential for any emulsion which was to be used as a dip, or which was to be applied by hand. First, the concentrated form of the emulsion should remain uniform indefinitely, this being necessary because the emulsion probably could not always be used immediately after its preparation, and under such circumstances, if the oil and water should separate upon standing, different portions removed from the stock emulsion would vary in composition; second, the oil should not separate rapidly from the water

after dilution of the concentrated emulsion, as is the case with the ordinary kerosene emulsion. Without this property the diluted emulsion would possess no advantage over a layer of oil on water, for the animals would take out each time practically the same quantity of oil, the irritating effects would be practically the same, and in addition it is doubtful whether the oil would be evenly distributed over the body of the animal.

A SATISFACTORY EMULSION OF BEAUMONT OIL.

The first trials with the kerosene emulsion formula given above showed that, although the Beaumont oil could be readily emulsified, the oil and water in the concentrated emulsion always separated upon standing. When this concentrated emulsion was diluted, the oil separated less rapidly than kerosene from a similarly prepared emulsion, but yet more rapidly than seemed desirable for a dip. With the object of eliminating these objectionable features, if possible, a number of modifications of the kerosene emulsion formula were tried by varying the proportion of first one ingredient and then another. After a number of trials of different combinations of crude oil, soap, and water, the following formula was decided upon as the one best suited to the uses we had in view:

Crude petroleum	2 gallons.
Water	$\frac{1}{4}$ gallon.
Hard soap	$\frac{1}{2}$ pound.

Dissolve the soap in the water with the aid of heat; to this solution add the crude petroleum, mix with a spray pump or shake vigorously, and dilute with the desired amount of water. Soft water should, of course, be used. Various forms of hard and soft soaps were tried, but soap with an amount of free alkali equivalent to 0.9 per cent of sodium hydroxide gave the best emulsion. All of the ordinary laundry soaps that were examined were quite satisfactory, but toilet soaps in the main are not suitable.

An emulsion of crude petroleum made according to this modified formula remains fluid and can be easily poured; it will stand indefinitely without any tendency toward a separation of the oil and water and can be diluted in any proportion with cold soft water. After sufficient dilution to produce a 10 per cent emulsion, a number of hours are required for all of the oil to rise to the surface, but if the mixture is agitated occasionally no separation takes place. After long standing the oil separates in the form of a creamlike layer which is easily mixed with the water again by stirring. It is therefore evident that for producing an emulsion which will hold the oil in suspension after dilution the modified formula meets the desired requirements.

In preparing this emulsion for use in the field, a large spray pump capable of mixing 25 gallons has been used with perfect success.

EMULSIONS OF OTHER OILS.

In using the formula herewith given it should be borne in mind that it is recommended especially for the crude petroleum obtained from the Beaumont oil fields, the composition of which has already been given. As crude petroleums from different sources vary greatly in their composition, it is impracticable to give a formula that can be used with all crude oils. Nevertheless crude petroleum from other sources than the Beaumont wells may be emulsified by modifying the formula given above. In order to determine what modification of this formula is necessary for the emulsification of a given oil, the following method may be used:

Dissolve one-half pound of soap in one-half gallon of hot water; to one measure of this soap solution add four measures of the crude petroleum that is to be tested and shake well in a stoppered bottle or flask for several minutes. If the proper proportions of oil, soap, and water have been used, a perfectly uniform mixture should result when one part of this emulsion is shaken with seven parts of water. If, however, after this dilution there is a separation of a layer of pure oil within half an hour, the emulsion is imperfect, and a modification of the formula will be required. To accomplish this the proportion of oil should be varied until a good result is obtained.

The object of this paper is to indicate the ease with which crude oil may be diluted by a process of emulsification, and also to show that the use of such emulsions for dipping or for hand application is entirely feasible. Their value as insecticides can only be determined by means of practical tests. Experiments are already under way with various parasitic skin diseases of animals, and it is hoped that the use of this emulsion may not only lessen the cost of applying the oil, but that the dilution with water and the presence of the soap in the mixture may remove all danger of irritation, which, as has been noted, sometimes follows the use of the pure crude petroleum.