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PARTICLE SIZE STUDIES USING A NON-THERMAL AEROSOL FOG GENERATOR DESIGNED FOR CONTROL OF ADULT INSECTS

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INTRODUCTION. Insecticidal aerosols are widely used by the Military Forces in outdoor applications for the destruction of adult populations of mosquitoes and other flying insects. From extensive use of available commercial devices it was concluded that the needs of the Military Forces could be met best by the development of a non-thermal aerosol generator providing for ready selection of the particle size making up the aerosol. When large quantities of insecticide are dispersed annually, as in the military operation, it is important that the correct particle size for maximum kill be achieved. For adult mosquitoes this is believed to be in the range of 20–30 microns mmd. This paper describes one in a continuing series of studies of equipment and methods of producing controlled sized particles in an insecticidal aerosol.

DESCRIPTION OF EQUIPMENT. The equipment used for these studies was a non-thermal aerosol generator designed and developed by Messrs. Robert G. Hahl and Harry N. Lowe, Jr., of the U. S. Army Engineer Research and Development Laboratories, Fort Belvoir, Virginia. The unit consists of a gasoline engine, a blower, an insecticide reservoir and pump, a unique but simple flow control system assuring positive control of the liquid flow rate and a nozzle and discharge assembly that can be adjusted to any desired position (Fig. 1).

The nozzles permit the use of a low

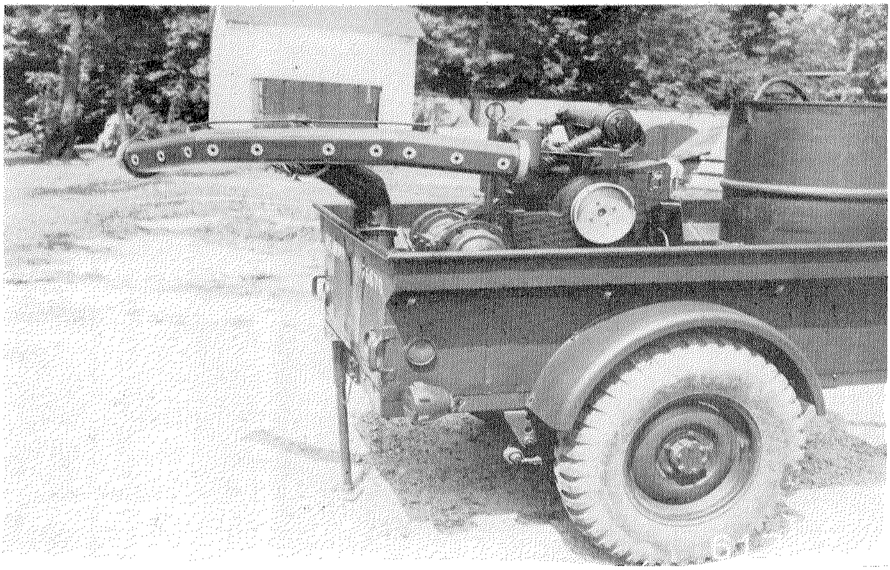

FIG. 1.—The Fogger, Insecticide-Aerosol, Gasoline-Engine-Driven, Outdoor Type, 40 GPH in ¼ ton military trailer. View of pneumatic atomizing nozzle boom. Particle Size Tests Non-Thermal Aerosol Fog Generator.

pressure, large volume air source to atomize the insecticide. One of the features of the nozzle is that it does not plug because there are no small openings or orifices.

The generator was designed to atomize diesel fuel oil No. 2 as the principal insecticide solvent since this material is the lowest cost and most readily available solvent in the field. Flow can be controlled at all values from 0 to 60 gph and air pressure adjusted to all values from 0 to 7 psi. From experience it was concluded that a practical operating range was from 30 to 60 gph at 5 to 7 psi.

PARTICLE SIZE TESTS AND RESULTS. Tests were first conducted at Fort Belvoir, Virginia and subsequently at the U. S. Department of Agriculture Experimental Station at Beltsville, Maryland. Results of these tests are summarized in Table 1.

To determine the size range of particles produced by the test equipment, a number of different solvents and formulations were atomized at different rates of flow and air pressures.

One part of twenty percent DDT oil miscible concentrate was added to two parts of diesel fuel oil No. 2 and atomized at 40 gph and 5 psi air pressure. The particles produced ranged from 22 microns mmd at 300 feet to 26 microns mmd at 50 feet. Using the same formulation but increasing the rate to 60 gph at 5 psi, the particles produced ranged in size from 28 microns mmd at 50 feet to 32 microns mmd at 25 feet.

When diesel fuel oil No. 2 was atomized at the rate of 40 gph and at 5 psi air pressure, the particles produced had a mmd of 20.2 microns. Increasing the rate of flow from 40 to 50 gph at 5 psi air pressure increased the mmd to 25.1 microns.

The control of particle size shrinkage, as the particles leave the nozzles and float through the air, was investigated. This

TABLE 1—Dri film slide data demonstrate particle size production of fogger, insecticide aerosol, 40 GPH Ambient 75° F.

Slide No.	Formulation (volume)	Flow Rate GPH	Air-pressure Psi	Distance Feet	MMD Microns	Location
1	Diesel #2	40	5	50	20.2	Beltsville
2	Diesel #2	50	5	50	25.1	Beltsville
3	Diesel #2	60	5	50	*18.1	Beltsville
4	Airplane Spray	60	5	25	23.6	Belvoir
5	Air. Spr. ½ dies. #2	30	5	50	10.6	Beltsville
6	Air. Spr. ½ dies. #2	40	5	50	26.1	Beltsville
7	Air. Spr. ½ dies. #2	40	5	300	22.1	Beltsville
8	Air. Spr. ½ dies. #2	50	6	50	26.1	Beltsville
9	Air. Spr. ½ dies. #2	60	5	25	32.2	Belvoir
10	Air. Spr. ½ dies. #2	60	5	50	28.0	Beltsville
11	Air. Spr. ½ dies. #2	60	5	300	31.1	Beltsville
12	Dies. #2 19/1 SAE 50	40	5	50	23.2	Beltsville
13	Dies. #2 17/3 SAE 50	30	5	50	18.1	Beltsville
14	Dies. #2 17/3 SAE 50	40	5	10	30.2	Beltsville
15	Dies. #2 17/3 SAE 50	40	5	50	25.3	Beltsville
16	Dies. #2 17/3 SAE 50	40	5	50	*33.6	Beltsville
17	Dies. #2 17/3 SAE 50	60	5	25	37.7	Belvoir
18	Dies. #2 17/3 SAE 50	60	7	50	17.3	Beltsville
19	Dies. #2 16/4 SAE 50	40	5	10	24.2	Beltsville
20	Dies. #2 16/4 SAE 50	40	5	50	25.7	Beltsville
21	Dies. #2 16/4 SAE 50	40	5	300	27.3	Beltsville
22	Dies. #2 16/4 SAE 50	45	5	25	27.0	Belvoir
23	Dies. #2 16/4 SAE 50	60	5	25	27.6	Belvoir

* Possibly not representative samples.

was accomplished by adding varying amounts of SAE 50 lubricating oil to the diesel solvent. It was found that a relatively large amount of SAE 50 oil, 18 to 20 percent, is required to cause any significant retardation of evaporation of the atomized particles at distances of 300 feet from the machine. Addition of less than 10 percent SAE 50 oil produced no measurable effect on evaporation rates. Particle size shrinkage due to evaporation of the diesel No. 2 and other oil solvents of this type is not considered serious enough to warrant the addition of costly and scarce supplies of SAE 50 motor oil.

DISCUSSION. Particle size measurement of aerosol particles is a painstaking task that should not be undertaken by other than thoroughly trained personnel. Even under favorable conditions it is desirable to have a check on results obtained by a second qualified investigator. This was accomplished effectively in these tests by dividing the laboratory measurements between the Engineer Research and Development Laboratories and the U. S. Department of Agriculture Experiment Station, Beltsville, Maryland. Good correlation of the measurements by the two laboratories was observed.

Control over the size of particles in an insecticidal aerosol is essential. Particles that are too small are deflected from flying insects by the air currents passing around the insects. Particles that are too large settle rapidly and have poor dispersion, the chances of hitting the insect being very much reduced. It is believed that the best particle size for killing adult flying mosquitoes outdoors is the range of 20 to 30 microns mmd. In this series of tests, particles in this range were produced at from 40 to 50 gph output at 5 psi air pressure. The tests indicated that other ranges of particle size can be produced by the test equipment by proper adjustment of the flow rate and air pressure. There is only one satisfactory nozzle commercially available for this equipment. This precludes the possibility of changing nozzles to produce varying particle ranges.

SUMMARY. A non-thermal aerosol fog generator was designed in a series of tests to produce an insecticidal aerosol in the range of 20 to 30 microns mmd. Several insecticidal formulations were used. With 6.7 percent DDT in oil, particles produced ranged from 22 microns mmd at 300 feet to 26 microns mmd at 50 feet, when the equipment was operated at the rate of 40 gph and 5 psi air pressure. Particle size was varied by changing either or both the rate of liquid flow and the air pressure used for atomization. Addition of 5–10 percent SAE 50 oil to the formulation did not produce a measurable reduction in the evaporation rate of the particles produced.

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THE MEMBERSHIP COMMITTEE

P. Bruce Brockway, Jr., Chairman of the Membership Committee, writes that his assistant chairman, Pat Nakagawa has been "doing an excellent job of signing up new members in Hawaii."

Since it is budget-making time for many Districts, Bruce included the suggestion that in states where such activity is permitted, "those in charge of the budget should look into the matter of memberships to be bought by the District itself. . . . Each District should realize that its primary source of information is the American Mosquito Control Association and that the Association stands ready to assist any District in any possible way; therefore, each District should reciprocate by maintaining membership in the Association. Furthermore, there are some Districts that owe their existence to the Association and they should reciprocate to the Association.

"Each member is morally obligated to let others know the full value of the Association and back this group by inducing others to join in our common battle on mosquitoes wherever it is deemed necessary."