MONOMOLECULAR FILM REDUCES EVAPORATION

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Of all the world's natural resources, water is one of the most basic to man's survival. In the arid regions of the world, water is in very short supply. As the population increases the strain on available supplies is becoming more acute.

One very important source of agricultural water in many arid regions is the farmer's or rancher's individual pond. The value of this water is multiplied many times in isolated areas where other water sources are unavailable. Conservation of this water is of critical importance. In many of these areas, the evaporation loss may amount to as much as six vertical feet of water per year. Not only is this water lost, but the water left behind is of lower quality because of the concentration of dissolved salts.

Evaporation Inhibiters

Water that ordinarily would be lost to evaporation can be saved by applying a material that will form a monomolecular film on the surface of the water. Films of the fatty alcohols, hexadecanol and octadecanol, have proven most successful. These alcohols have a long carbon chain molecule, one end of which is attracted to water, the other end being repelled by water.

These attracting and repelling forces cause the long alcohol molecules to stand perpendicular to the surface of the water in a monomolecular film. The thickness of this monomolecular layer is approximately one ten-millionth of an inch.

Films of these materials are not toxic to animals or plants. They offer no appreciable resistance to oxygen or carbon dioxide diffusion, yet they have high ability to suppress evaporation of water. The theoretical amount of this material necessary to form a monolayer on water is quite small (0.08 lb./acre).

Even at a cost of about 50 cents a pound for the material, the economics of evaporation suppression by this method are quite promising. In laboratory experiments using four-feet diameter pans these films were able to conserve as much as 65 per cent of the water normally lost to evaporation.

Savings Up to 30 Per Cent

The Australians were the first to try using the hexadecanol monolayer to prevent or suppress evaporation on reservoirs back in 1952. They reported that they obtained up to 30 per cent savings on small reservoirs by dispensing the hexadecanol in flake form from gauze floats.

The Australian results interested various governmental research agencies in the United States where testing of monolayers on reservoirs began around 1955. Various estimates of the cost of saving water in large reservoirs have been made. These range from $4.50 to $300 per acre foot.

There is no question that the monolayer film will reduce evaporation. The problem is trying to maintain a film coverage so as to maximize savings with a minimum cost of water saved. Factors which break up or destroy the film coverage are wind, bacteria and sunlight. Of these, wind seems to be the most important, because if a wind is blowing the film will not remain on the water long enough to be destroyed by sunlight and bacteria. Since the evaporation rate is very high during periods of wind, continuous application of the material is necessary if maximum savings are to be obtained.

Can Be in Many Forms

The various physical forms of fatty alcohols that can be applied are: (1) powder, (2) solid, (3) molten, (4) solution, (5) emulsion or slurry, and (6) flakes. Of these forms, powders, solutions (in hot weather), and emulsions seem to be giving the best results.

Molten hexadecanol can be sprayed through a nozzle to form a powder but the equipment involved makes it impractical for small ponds. On the other hand, the use of solvents may prove to be practical on a small pond because of the relatively cheap equipment required. However, it would not be practical on a larger reservoir where cost of the solvent would be prohibitive. Thus, method and cost of application depend on the size of the reservoir. The type of dispensing equipment suitable for a large reservoir probably would not be economically feasible for stock ponds.

In July 1961, the Institute of Water Utilization of The University of Arizona entered into a contract with the U. S. Bureau of Reclamation to find the best combination of the various chain lengths of fatty alcohols, the best physical state to use, and the best apparatus to use for stock ponds and reservoirs under 10 acres in size.

'Film' Pond and Check

For field testing purposes, duplicate ponds 53 by 78 feet in size were built and lined with vinyl plastic to prevent seepage. A stilling well and a hook gage at each pond is used to measure change in water storage. The testing procedure calls for applying the film on one pond and comparing the water loss with that from the untreated pond.

To date, screened rafts with flakes of hexadecanol inside have been used with little or no savings. Solid material in the form of doughnuts have also been tried with no savings. Powder has been applied three times daily, resulting in savings of 6 to 10 per cent. A self-feeding grinder-duster, which is a scaled down version of the one the Australians developed, has been built.

The grinder-duster consists of a small six volt motor and a wire brush, with a feed system where the hexadecanol is fed into the grinder, using a weight and pulley system. By using this duster, we have completely covered a 1½ acre lake within a matter of minutes with a film of maximum cover. However, it may prove to be impossible to keep a pond covered dispensing from only one or two points during high winds.

Solutions using common white gasoline as a solvent have been tested, using a simple dispensing apparatus which utilizes the difference in specific densities between white gasoline and water. A bottle containing fatty alcohol dissolved in white gasoline is placed on the bottom of the reservoir and coming out of the bottle are two glass tubes. One tube extends to the bottom of the bottle. This tube allows the water to enter. The fatty alcohol in solution will float to the top of the bottle and will be forced out the plastic tubes leading to the surface. These tubes lead to wind vanes on the ponds

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What YOU Can Do

Donald V. Robertson

"Ask not what your country can do for you. Ask what you can do for your country."

All hearts were stirred by this challenge voiced by President Kennedy in his inaugural address. All ears waited to hear what needed doing. All responsible citizens searched for a way to help their country.

Americans responded in different ways to the challenge. Some joined the army. Some volunteered for the Peace Corps. Some became active in community affairs. But most still wait for instruction as to the best way they can serve their country.

To those who wait, we have a suggestion: Do your best.

By doing your best you can help combat a doctrine that is fast engulfing America -- a doctrine more dangerous than Communism or Fascism or anarchy -- the doctrine of Good Enough.

The mechanic who does a half-way job (it's good enough), the manufacturer who uses shoddy parts in his product (they're good enough), the scientist who is satisfied with slipshod, inexact research (it's good enough), the student who plays and loafs and gets barely passing grades (they're good enough), all are unwitting participants in this silent conspiracy of mediocrity. Unless it is reversed, this conspiracy, this unconscious treason, can make America second class more quickly and more surely than conspiracies that deliberately work for America's destruction.

But the conspiracy of mediocrity can be reversed. Each person need only do the best he can. He may not achieve perfection in his job; few are capable of it and circumstances do not often allow it. But he must conscientiously strive for perfection.

Only by doing his best can a person realize his greatest potential as a citizen, an employee, and an individual.

So to serve your country, to serve your employer, to serve yourself: Do your best.

Editor's Note: The above was written by Donald V. Robertson, publications editor in the Agricultural Research Service, U.S. Department of Agriculture, Beltsville, Md. It was included in a writing assignment given University of Arizona and USDA personnel in Tucson a few months ago. We felt it deserved a wider audience.

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that keep the material applied into the wind.

Using this apparatus, savings of from 15 to 20 per cent were obtained. Before additional tests could be made in the fall of 1962, the temperature began to drop below 60°F. at night. This caused the alcohol to precipitate out of solution, which plugged up the dispensers. Further tests made in the laboratory showed that the solubility of alcohol in white gasoline was very temperature dependent and not practical when temperatures dropped below 60°F.

Next — Emulsions

Because of this unforeseen development, testing with solutions was stopped. Emulsions were tried next. Various types of emulsifiers and alcohol concentrations have been tried. A stable emulsion containing as high as 10 per cent alcohol, which can be fed by gravity through a quarter inch plastic tube, has been used. Emulsions of various concentrations of alcohol and emulsifying agents will be tested further. To date savings of water as high as 30 per cent have been obtained using a 10 per cent concentration of alcohol, feeding the emulsion continuously by gravity.

Although there needs to be a lot of additional research done to determine the optimum physical form and the best means of dispensing the monolayer, it now appears that emulsions fed through a gravity feed system are the most promising, at least as far as small reservoirs and stock ponds are concerned. Most of the remaining time in this project will be spent in testing emulsions.