EVAPORATION REDUCTION OF WATER PLANS IN ARID ZONES BY MONOMOLECULAR FILMS (CASE OF OUARGLA)

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ABSTRACT

The study presents a technique of the reduction of the evaporation of water plans by the use of a monomolecular film. To know the efficiency of this technique in our arid zones, an experimental device consisted of three pans type Colorado, partially covered, was installed in the ITDAS experimental station; the first one is covered by a film of Hexadecanol, the second by a film of a mixture of Hexadecanol and Octadecanol with equal proportions (1: 1), the third (observation pan) contains only water. Alcohols are put on water plans every three days (0,336 g / 03 days / pan).
The daily observations during 15 days allowed deducting that films reduced the losses by evaporation and the rates of reduction of the evaporation are remarkable and are more than 30 %.

Keywords: Evaporation, Monomolecular films, water plans, arid zones, Ouargla.

1. INTRODUCTION

The arid zones are characterized by high temperatures (up to 50°C), weak precipitation (less than 200 mm), low rates of humidity, and of high evaporation (2 to 3 or 4 m/year in arid zones and 5 to 6 m/year in hyper arid zones according to ROGNON (2000)).

The shortage of water areas in these zones with the presence of the intense evaporation increase the risk of the drought and desertification, lead to the necessity of looking for a means, to reduce the evaporation as to preserve the existing water plans.

The present study consists in presenting of evaporation reduction technique by the use of a chemical substance capable of forming a thin layer called "film" on the water surface in the region of OUARGLA (south-east of Algeria).

2.EXPERIMENTATION

The study was realized during summer season when the average air temperature was more than 33°C with a maximum temperature of 41°C, the average relative humidity is more than 37 % with a minimum relative humidity of 19 % and duration of insulation of 154,3 hours (43 % of the totality of the period of study) (winds between 10 and 30 Km/h). For the place, the experiment was realized in Hassi Ben Abdellah's region in approximately 27 Km in the northeast of Ouargla.

3.MATERIALS AND METHOD

3.1 Materials

3.1.1 Pans

pans of evaporation , contrary to the equipments of measuring evaporation which measures a purely climatic characteristic eliminating the influence of the reservoir, aim at getting closer as much as possible to conditions presiding over the evaporation resulting from extents of natural water (Roche 1963). For this work the chosen tubs are pans of type Colorado already adopted by the service of the Hydraulics in Algeria (Dubief 1950), with the dimensions of one meter square of surface and one half-meter deep.

3.1.2Chemical substances

There are chemical substances which form on the surface of water a film of single row of molecules directed with regard to this surface in the same way: the hydrophilic liqueur brandy managed downward and the hydrophobic managed upward. The formed film on the water surface is not disrupted by winds of less than 5 m/s if the supply of the water surface by the chemical substances is made regularly continuously (Braslavski et al. 1965).

For our study we chose the Hexadecanol ($C_{16}H_{34}O$) and the Octadecanol ($C_{18}H_{38}O$) who are alcohols with length chain in the form of powder capable of forming monomolecular films, this choice is based on the study of LaMer (1965) which gives the tradeoff between a high resistance and a low spreading rate. Hexadecanol, with 16 carbons, has a specific resistance about 1 / 14th that of C_{22}, but the spreading rate is almost 100 times greater.

Thus the choice is made because both alcohols tend to extend quickly to cover the surface of the water at time t shorter than for the other alcohols or the fatty acids (of C20 and more) in spite of these last ones have a high resistance.

The adequate quantities of the used alcohol (Hexadecanol and Octadecanol) in the form of powder were defined after several tests on field (Frenkiel 1965).

3.2Applied method

Pans, filled with water at 80 % (which is 400 l by pan), were partially buried one meadows of other one by keeping a 50 cm space and a 10 cm height above the natural level of the ground. The water levels appreciably at ground level.

For chemical substances which are in the form of powder are put on the water surface of the first two pans every three days as follows:

- For the pan 1 a quantity of 0.336g Hexadecanol;
- For the pan 2 a quantity of 0.336g of mixture of Hexadecanol and Octadecanol alcohol (0.168g: 0.168g) and

- For the pan 3 no substance was put and it is as observation pan.

It is necessary to note here that the condition of insures the efficiency of the monomolecular film is the absence of the wind which created waves on the water surface. Thus it is necessary to make sure that the wind is quiet during the spread of the powder on the water surface.

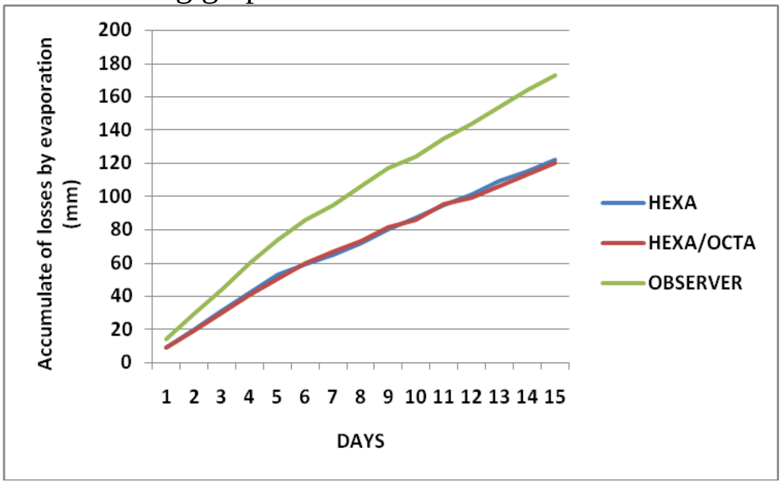
This operation made every three days for all the period of study.

For the measure of the losses by evaporation in pans and meteorological parameters they were made every day and when water goes down we refill pans until initial level.

4.RESULTS AND DISCUSSION

4.1Results

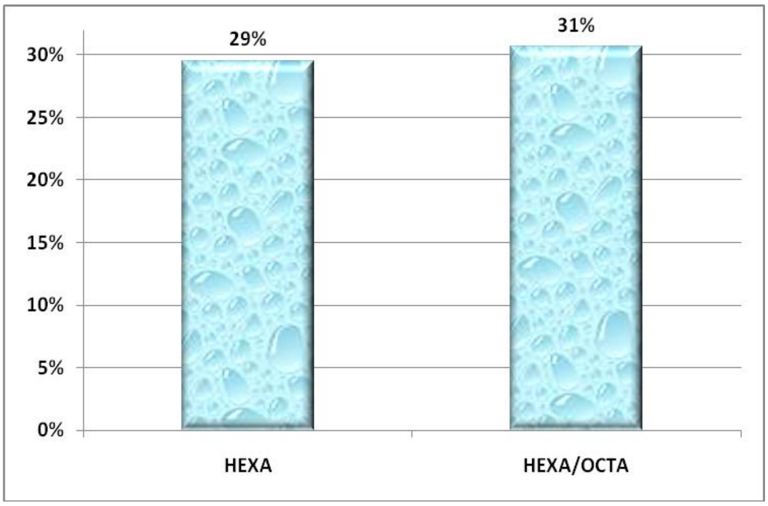
The results of the losses by evaporation in four pans during 15 days of observation allowed having the following graph:



Graph 1: accumulate losses by evaporation (mm)

The graph 2 giving good results of the losses by evaporation .

The comparison between curves shows that there is difference which becomes more and more important between accumulates losses by evaporation of the observer pan and accumulates losses by evaporation of the other pans covered by monomolecular films.



Graph 3: Rates of the evaporation (%)

The graph 3 gives the rates of the evaporation reduction in three pans with regard to the pan observer. The obtained values are very close but with an advantage in the case of the film of mixture of Hexadecano and Octadecanol with a rate of 31 %.

4.2Discussions

The mean values of the losses by evaporation for every pan confirm the efficiency of the monomolecular films in the evaporation reduction of the water plans.
This efficiency varies according to the chemical substance used to form the monomolecular film and the meteorological factors especially wind and air temperature.

The value of rate of the evaporation reduction is raised in pan 2 where the monomolecular film is of mixture of Hexadecanol and Octadecanol (31%).

This value is explained by the meeting of both advantageous characteristics of both used alcohols, these characteristics are the rate of initial spreading raised of the Hexadecanol and specific resistance raised of the Octadecanol.

For the wind, the values measured during the period of experiment do not exceed 5 m/s in most part of time and when they exceed the monomolecular film concentrates in one part of the pan which explains the presence of some important values of losses by evaporation in pans covered by the film these results agree with those of Mansfield (1958) who concluded that the actual rate of evaporation from water covered by a monolayer becomes almost independent of wind velocity beyond a limiting velocity (which is determined by atmospheric conditions).

For the temperature, Mansfield (1956, 1958) has found that the evaporation resistance of a monolayer generated directly from a fragment of solid highly purified Hexadecanol placed upon a water surface was approximately constant in the temperature range of 20°C. to 30° C., but that the resistance fell rapidly at higher temperatures so that at ,50° C. it is about one fourth of its value at 20°C; thus more the temperature increases more the resistance in the evaporation is low, the results obtained in the experience give values of rate of evaporation reduction between 29 % and 31 % for an average temperature of this period of 33°C.

5. CONCLUSION

The study of covering water surface regularly every three days by chemical substances (Hexadecanol and Octadecanol) forming a thin layer called "film" allowed to confirm the efficiency of these substance in the reduction of the evaporation of water plans.

The rates of the evaporation reduction depend on chemical substance used and on meteorological factors of the region.

The film with the mixture of both Hexadecanol and Octadecanol gave the highest rate of reduction (30 %), this result confirms that obtained by Barnes (1962) and Gugliotti et al (2005). For monomolecular films with the Hexadecanol only the obtained rate is not far from that of the film with the mixture and is 29%.

At the end, it is necessary to know that the obtained results are approximate and still require more experiments in this field.

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