Chapter I

Introduction

Water absorbing polymers (WAP), first synthesized in the 1970's, have the remarkable property of being able to absorb water for several hundred times their own weight. Starting off as a powder they become like a gel when saturated with water. They are sometimes sold as a jelly-like potting medium in plant shops. But of greater economic potential they have been widely mentioned in the context of agriculture and their role in increasing water retention in soils.

WAP can play an important role in the national afforestation campaign currently being implemented. WAP can conceivably be used to increase moisture content in soils around tree seedlings thereby ensuring higher seedling survival rates.

One of the earliest water absorbing polymers synthesized and tested, commercially known as H-SPAN, is a hydrolyzed starch polyacrylonitrile graft copolymer. This particular product was developed by the United States Department of Agriculture, SEA-AR Northern Regional Research Laboratory at Peoria, Illinois, and has been under study since 1975 (P.Hemyari and D.L.Nofziger,1981).

W.D.Shrader and Akbar Mostegeran(1977) studied the effect of various mixtures of WAP on different soil textures,soil properties on plant growth. The starch-polyacrylonitrile polymer they used indicated an increase in water holding capacities in many types of soil using a concentration of 1:500 WAP to soil by weight. And although they found that WAP had only a little effect on medium-texture soils but that holding capacities for sandy soils were greatly increased. But in order to increase water holding capacities of sandy soils with WAP to the level of water holding capacities of medium-texture soils the amounts of WAP needed would be prohibitively expensive at current production costs. D.E.Miller (1981) found that 0.5% by weight of H-SPAN added to the upper 60 cm of sand increased available water retained to nearly the same level as that of a loam and silt loam soil. It was also found that presence of H-SPAN reduced infiltration rates in all soils.

P.Hemyari and D.L.Nofziger (1981) undertook similar studies on another hydrolyzed starch polyacrylonitrile graft copolymer with concentrations in selected soils from 0 to 0.7% by weight. In general it was found that WAP decreased infiltration in the soils tested. Concerning retention of water it was found that WAP had little effect on water retention in clay loam soils but loamy sand and sandy loam soils treated with WAP retained more water than the untreated soils.

James L.Hamilton and R.H.Lowe (1982) used WAP to aid in the production of barley tobacco transplants and to increase the survival of transplants. WAP kept water in contact with seed, and improved the rate and uniformity of germination in a leach soil. A slurry of WAP and water as a root dip maintained roots in a moist condition, reduced wilting of the seedling and resulted in better survival. However, the effect of WAP was destroyed by fertilizer salts.

Water retention in soils is probably function of several factors for each type of soil studied such as absolute soil water retention capacity, day-time heat penetration capacity, rates of water evaporation as a function of temperature, and ambient air conditions.

In this initial study of the transport phenomena governing movement of moisture in water bearing soils it was felt that an important set of data needed was data on evaporation of water from soils. In particular this work will study evaporation of water from the top of sand columms under isothermal conditions both with and without the addition of WAP in order to better understand the mass transport phenomena and the influence of WAP so that initial considerations can be made on the use of WAP in agriculture.

Objectives

The objectives of this work are

1. To experimentally study the effect of WAP on the water retention property of sand mixed with WAP.

2. To experimentally determine the diffusion coefficient of water in sand mixed with WAP.

Scope of work

In order to acheive the above objectives, the following works are conducted:

1. Study the property of WAP.

2. Study the diffusion equation.

3. Design and construct the experimental apparatus.

4. Conduct the experiments under the ambient air conditions :

    a. 30, 40, and 50 degree Celcius

    b. 25% and 40% relative humidity.

5. Mathematically determine the diffusion coefficient of water in the sand bed during evaporation.

6. Discussion of results.

Benefit expected

This work should provide

1. the effect of WAP on the water retention property of sand mixed with WAP under the experimental conditions.

2. the simplified diffusion equation that described the overall diffusion phenomena in the sand mixed with WAP column.

3. the ability to approximate the water content in the sand mixed with WAP column at distant time.