ABSTRACT

The extent of energy losses in sprinkler irrigation system due to turbulence in pipes and in other components is quite high. To mitigate this problem, the turbulent drag reducing property of polymeric additives is applied in this research. A few ppm of water soluble polymer added in irrigation water can reduce the drag in pipes considerably and hence the energy losses and also the polymer added water percolates slowly in soil which further enhances the water conservation.

Natural polysaccharides like amylopectin, guargum and starch were procured from commercial sources. Guargum was purified by soxhlet extraction method to remove the low molecular weight impurities like fats and proteins. Polyacrylamide was grafted on to the backbones of these three polysaccharides by ceric ion induced redox method to produce three grafted polymers named as polyacrylamide grafted amylopectin (Ap-g-PAM), polyacrylamide grafted guargum (GG-g-PAM) and polyacrylamide grafted starch (St-g-PAM).

These three grafted products were characterized by IR spectroscopy, XRD and thermogravimetric analysis to prove the grafting process. Also elemental analysis was carried out to know the various compositions of the grafted products. Intrinsic viscosity, relative viscosity measurements were carried out and molecular weight of all the grafted polymers were evaluated.

These three grafted polymers along with purified guargum and commercial guargum at various concentrations were mixed with irrigation water applied through a sprinkler irrigation system and the drag reduction, energy reduction and increase in diameter of coverage thus obtained were measured. Experiments were conducted at various flow rates of water to investigate the effect of flow rate of water on drag reduction characteristics of polymer solutions. The polymer solutions were mixed in the water applied through sprinkler irrigation system by homogeneous method of application, inlet injection method and a modified ventury outlet injection method. The effect of various methods of polymer solution injection on the drag reduction, reduction in energy requirement and increase in diameter of coverage of sprinkler irrigation system was investigated.

The infiltration rate of the soil with various concentrations of polymer mixed water was measured by double ring infiltrometer to investigate the effect of drag reducing polymers on the infiltration characteristics of soil.

Design software *"SPRINKSOFT"* was developed to design the sprinkler irrigation system for both water and polymer mixed water by finite element formulation of various system components. Darcy-Weisbach equation was used for friction head loss calculation in the software. The Blasius equation was used for calculating friction factor in case of water. In case of polymer mixed water, a different relationship between friction factor and Reynolds number suggested by Virk (1971) was used. The software was developed in Visual Basic Environment to give it a Graphic User Interface. The output of the software was compared with the observed results by computing the Relative Error Percentage.

With the help of the developed software, design was made for a standard sprinkler irrigation setup for a unit depth of application of irrigation water. The changes in the various system components with polymer mixed water was investigated and finally, the total energy consumed and total operating hour needed to apply a particular depth of irrigation water in the field was found out.

Key Words: ***Drag reduction, Grafted polymers, Injection method, Infiltration rate, Design of sprinkler irrigation system***