M.Sc THESIS

PLACEMENT OF PERMEABILITY RETARDING MATERIALS INTO CANAL PERIMETRIC SURFACE FOR SEEPAGE CONTROL

Submitted By

TARIQ SHAHZAD
(2007-PG-WRE-12)

For the Degree of

MASTER OF SCIENCE

IN

WATER RESOURCES ENGINEERING

CENTER OF EXCELLENCE IN WATER RESOURCES ENGINEERING
UNIVERSITY OF ENGINEERING AND TECHNOLOGY, LAHORE

2009

ABSTRACT

Water plays very important role in a country's wealth. Although about 88 % of water is used in the agriculture sector. The country's production is also greatly affected by the quantity and quality of the available water. Population growth, quick urbanization and industrialization are forcing growing demands and pressures on water. Irrigation canals in Pakistan suffer tremendous water seepage losses due to unlined section of the canal. The present study aimed to investigate performance of sodium bentonite mixture blanket placed in the canal bed for seepage control and to find the sort of mixture combination that could be used under specified canal conditions for seepage control.

The soil sample was selected which have the same characteristic as that of canal bed material of Thal area. Initially soil seepage rate/hydraulic conductivity were determined on small scale in porceline cylinders. Seepage rate of 9.782 cm/hr was observed through soil before treatment. The soil was treated with different percentages of sodium bentonite on weight basis i.e. 20%, 10%, 5%, and 3%. Seepage rate/conductivity was measured for bentonite treated sample after 24 hrs. From these tests zero seepage rate was observed for 20%, 10% and 5% percentages of sodium bentonite treatment and 1.5 cm/hr for 3% treatment. It was observed that 5% bentonite mixture is the desired mix ratio that could be applied for seepage control on canal parametric surface resulting in near zero seepage rates. To substantiate the results an experiment was made in a large tank of area 1 m^2. Seepage rate of 10.194 cm/hr was observed before treatment in the tank. The sand and bentonite was mixed on 5% bentonite ratio by weight. Further experiments were conducted to find the sustainability of soil bentonite mix layer in flowing channel under lab condition. A section of 1.5 m long and 0.60 m wide of lab channel was isolated and filled with the soil sample. Arrangements were made to

separately measure any seeping water through the channel bed area of 0.9 m^2. Before treatment, 8.91 cm/hr of seepage rate was observed in flowing channel. Bentonite slurry was formed by mixing 5% of sodium bentonite on weight basis with the base material of the channel bed of 25 cm depth and applied to the channel bed surface. The observed seepage rates after treatment were 1.787 cm/hr, 0.466 cm/hr, 0.712 cm/hr, and 0.60 cm/hr for 1st, 2nd, 3rd and 4th days respectively. A seepage measurement ditch was designed in the water course. First a bypass channel was constructed to divert the water to do preliminary work in the experiment channel. The experimental ditch was constructed of rectangular shape. The ditch was then filled with sand up to 30 cm to equalize with actual field conditions. Before treatment 3 cm/hr seepage was measured under field conditions. Bentonite soil slurry (5% sodium bentonite by weight) was applied over the surface to form a 15 cm thick layer. Seepage measurements were equently measured for 16 days. The seepage rate of 0.205 cm/hr was observed on 1st day after treatment which decreased gradually to a seepage rate of 0.128 cm/hr on the 16th day, it means that seepage rate decreased by 93% to 96% in 16 days after treatment. Experimental study proved that sodium Bentonite admixture layer can successively serve as seepage barrier as bentonite's swelling fills the pores or voids between the sand particles and effectively control the seepage through soil. Best mixing percentage of sodium Bentonite with sand is 5% by weight for effective and practicable canal seepage control. It is recommended that soil bentonite mixture by 5% weight basis may be used effectively to control seepage in canals with sandy textured bed materials. Studies should be done to find out best method of mixing and placing soil bentonite mixture (slurry or dry mix) under flowing canal water condition. The seepage results should be observed for long period of time say for six months to find the maximum stability of mixture on canal bed surface.