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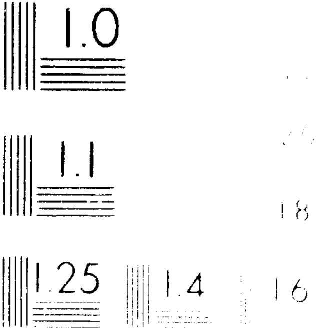
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RETURN MISSION - 15 DAYS FROM 19TH AUG.,

TO 2ND SEPT., '82.

[Egypt. Use of polythene film for water storage]

F I N A L   R E P O R T.

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Introduction:-

My earlier mission for 2 months commencing Dec. 4th, '81 to end Jan. '82, was to an extent incomplete as the supply of Black Wide Width Polythene film that had been ordered very much earlier, somehow got untraceable in the docks and I could only attempt, during the last few days of my mission, the lining of a small field channel with whatever film that could be readily located.

The use of Polythene Film in Water Management needs many technologies adapted to different situations. Lining of canals for seepage loss control, Lining of Water Ponds, Reclamation of very porous soils for cultivation using less irrigation water by establishing a thin Polythene membrane underlay below the sandy soil, are all technologies which have been extensively tried out in India with uniform success. Egyptian conditions of soil & overall constraints on fresh water availability, make these technologies useful for adoption.

The return mission was organised specifically to line a large underground water storage pond. Underground ponds are extensively used as a method of harvesting rain water for subsequent irrigation and cultivation, of limited areas around these ponds. These ponds are constructed with brick in cement and are covered on top with an R.C.C. slab after providing small square openings (usually 2 or 3 of approximately 2' x 3' each). The extremely porous nature of the soil in which these ponds are located, needs very compact careful masonry. Construction of the side walls and the bed (with large quantities of cement being used) make them only rather impervious to that water that is impounded. A Polythene membrane lining can effectively hold back loss of water from these underground tanks by seepage and since the barrier properties of this film are relied upon entirely, a much poorer cement sand ratio can be adopted for the construction of the walls and bed as well as for plaster.

The Mission:

The first three days of the mission were utilized by Mr. Sabry of UNDP, Cairo & Dr. Abu Zeid of P.D.C., Alexandria to prepare an urgently required Assessment Report on P.D.C. Alexandria. This report was originally meant to be prepared by Dr. Gurrana of Egyptian Plastics, Alexandria. Since his last minute involvement in Elections to the Parliament, he was unable to prepare this report and so on the request of both Mr. Sabry & Dr. Abu Zeid, I sat up at P.D.C. for the three days and wrote out the entire report in cooperation with Dr. Abu Zeid and Mme. Nossier.

On Wednesday the 25th, I reached Mersa Matrouh and visited the excavated large pit for construction of the lined tank. Although the pit size was originally mentioned in the telex to me in India as 22 M long x 5 M wide x 4 M deep, it actually measured app. 33 M long x 8 M wide x 4 M deep. The excavation was however not dimensionally uniform. It was 33 M long on one side and about 1/2 M less on the other. Also the excavation was not straight, either along the length or the vertical face which was inclining inward one one side and outward on the other. The 8 M sides also were similarly defective both on dimensions as well as on the plumb check for true verticality of excavation.

There were only 4 days to execute the job and if I had asked for the corrections on excavations to be made before starting to construct the lined tank, no progress could have been achieved within the very limited time available. To ensure that the P.D.C. staff who had come with me should know this technique by actual field experience I started the work without waiting for the pit to be dimensionally correct. However, it is most important to have a dimensionally correct excavation to succeed with this lining technology. The corners should be proper right angles and the sides should be straight and true to the plumb line to make the lined tank construction free from complications. If this is not adequately taken care of, the sieved sand that sandwiches the Polythene Film, underneath the brick construction will be uneven and may create heavy side thrusts on the brick wall (sometimes to the extent of collapsing it) if the excavation slopes heavily outward from the bottom. This started to happen on one of the side walls and urgent buttress wall construction had to be taken up to hold the wall from total failure.

The excavated pit needs to be carefully inspected for sharp stones and other objects like cutroots etc., and these have to be smoothened out by hammering, tamping or cutting off roots deep enough. A spread of fine sand (one or two inches) on the bed will prevent the Polythene sheet from damage by puncture etc., while laying. Calculated length of 6 M wide 250 micron black Low Density Polythene film are cut and spread from one end of the pit, the first length being placed in such a way that the vertical side wall is covered adequately for the 4 metre depth and at least a metre for anchoring the extra film on the top edge of the pit into a 6" x 6" deep groove cut along the ridge of the pit all round at the top. The extra film is depressed into this groove and covered with sand, thereby giving it a good anchorage all round the pit on top.

....3

At the bed, the next length of film is brought up close enough, after centering, so that there is at least a 0.5 M overlap between adjacent layers of film. The two films to be joined leakproof have to be cleaned and after spreading hot melt bitumen between the two sheets, they should be foled together 3 or 4 times and anchored to the floor with a sand cushion and bricks laid on the folded joint to prevent it from opening up.

The construction of the tank wall from the end where the film has been spread should be started after spreading a thin cushion of sand over the film. It is important to ensure that the labour who handle the film should clip their finger and toe nails and also not wear hard souled shoes - particularly with nails etc. All the masons should be cautioned not to use their metal trowels in such a way that it might damage the film.

The biggest single problem in this installation was the complete change of masons & labour, every day, necessitating the wasteful education, repeatedly, of the technique, its do's and don'ts and a warning every morning to the people that the success of this technology entirely depends on a totally undamaged Polythene Film layer being left below the civil construction and that any damage, anywhere would seriously affect the efficiency of the tank.

In spite of the precaution, warning and every morning starting exercise of collecting everybody and lecturing to them about the precautions necessary, two or three incidents that happened in this short period I was there (4 days) are worth noting, to avoid similar problems in the future, while adopting this technology.

(1) The workmen who dump the white limestone bricks into the pit from above were warned to keep clear of the spread Polythene Film & not to damage it. This warning was inadequate and on the second morning, when we reached the spot, the film had been damaged in a number of places by the bricks being dropped from the top of the pit over them.

(2) The labour should be warned that the film is extremely vulnerable to damage and any tool or cement carrying tray thrown on it, even with the thin sand cushion could easily damage it. One of the labourer, who had a heated exchange with the mason, threw the metal cement tray on the film in anger & damaged the film.

(3) While the masons are constructing the walls, particularly while chipping & trimming the bricks, the sharp pieces of bricks dropping on the film will damage it. Care should be taken to prevent these landing directly on the film.

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In all these cases of damage, the film was cleaned of sand & dust for about 1/2 M radius around the damage and a fresh piece of film was spread after generously spreading hot melt bitumen around to stick the two layers together. The joint was then adequately covered with sand cushion and bricks were laid over it. While this is the only way to solve the problem of damage to the film, it is certainly not desirable and the technology not so perfect as when you could totally avoid damaging the film while laying and covering.

Within the limited time available, I could only demonstrate the way of spreading the film for the two end walls and also making two joints both at the bed and the vertical sides. I was reasonably confident that the 4 P.D.C. staff who worked very hard with me on the job could continue and complete the job in my absence.

It was however unfortunate, as mentioned earlier, that the excavation of the pit was far from regular and to correct dimensions. As a result of sand filling, between the vertical wall (built to plumbline from bed level) and the tapering excavation kept increasing so heavily to the top of the pit that the sand pressure started to cave in the wall. Urgent wooden supports were kept to prop up the buckling wall and a quick buttress wall support from the bed of the tank was got up. This complication could have been totally avoided if the excavation was correct to a plumbline and sand filling could have been reduced.

The bricks used were sliced lime stone bricks which is extensively quarried in this area and measures approximately 6" x 6" x 1-1/2' and they are heavy. The walls were double layer bricks and bed, single layer. 1 : 6 cement sand mortar was used and the final surface on the inside was to be plastered with the same mortar. In view of the large span involved, I had suggested that some pillars should be raised to reduce the span before casting the R.C.C. top cover for the tank.

The other part of the mission to line a channel 50 M long 1/2 M wide and 0.3 M depth could not be taken up (a) as this stretch had many plant growths including casurina and (b) for want of time to relocate any other canal stretch.

VISITS TO THE SITES COVERED BY MY FIRST MISSION:-

I. Canal Lining at Nubaria: On my way from Cairo to Alex, I stopped at the canal lining site in Nubaria where I had laid the film with mere soil overburden by excavating in several steps on both sides. There was weed growth on the overburden soil and as the roots were not any deeper than the film layer, these weeds could easily be pulled out by hand, complete from root level. Also, since overburden soil compaction after spreading the film was not adequately done, there was a certain loss of cover over the film. This was particularly severe in the initial few feet of the canal where the high entry velocity had dislodged the soil. In view of the importance of the correct performance of this first canal lining job in Egypt, early steps to replace the lost soil should be taken and the soil should be adequately compacted. At the time of initial laying, no wetting and tamping of the soil overburden could be done and hence this small problem.

II. Drip Irrigation on Olives at Mersa Matrouh:

I visited the 75 Olive trees (16 year old) that were covered by Drip Irrigation with 3 point wetting. The÷ plant response was excellent. While the furrow irrigated area in this orchard continues to yield only scanty and poor results, these 75 trees have borne copious fruits and all the plants look markedly healthier than the others. Unfortunately this orchard is so far away that not many farmers or officials can easily reach out and see the results. It is very urgent and important that a suitable orchard should be identified and equipped with Drip Irrigation system, close to Alexandria or Cairo so that its advantages can be visually demonstrated to propogate the technology. Even on this installation I have to comment that some of the components have broken down, particularly the spaggeti pipe and a few others. These have to be urgently rectified so that the technology which is so definitely useful for this area, does not suffer a bad name.

CONCLUSIONS:- Either Canal Lining with Polythene film or tank lining and above all Drip Irrigation is most advantageous for Egypt to adopt on an extensive scale. In fact, there are far more compelling circumstances for its large scale adoption in Egypt, than most other countries like India, where they are already an accepted and technically successful practice. Lack of trained personnel would become the most serious problem. Particularly for designing the full Drip Irrigation system with all the problems of assessing the filtration requirements, designing pipe network diameters, assessing and advising farmers on Plant water requirements and nutrient inputs etc., are tricky problems. It would need constant and sustained work with technicians working on these problems in countries with similar levels of adopted sophistication. Highly automated systems or those working on sustained pump pressures would not suit and in India, over the last 3 years, experience has shown that overhead tank fed Drip Systems are the easiest to adopt. Conditions in Egypt are even more

....6

compelling than in India, to adopt simple, effective systems. P.D.C. should aim at giving this advise and complete technology to the farmers.

I am enclosing a note that was urgently prepared for the Minister for Land Reclamation, Mersa Matrouh Mr. Allam, with whom I had a very interesting lang talk on Drip Irrigation and so I felt this could form a part of my report.

VALIDITY OF DRIP IRRIGATION COMBINED WITH POLYTHENE FILM LINED UNDERGROUND WATER PONDS IN THE MERSA MATROUH AREA.

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INTRODUCTION:- The stretch of land along the sea coast extending from Alexandria to Mersa Matrouh and beyond is typically dry sandy soil with low humous and consequent poor water holding capacity. The rainfall is the only source of fresh water and this soaks into the soil forming a distinct thin layer on top of the otherwise saline aquifer. Many underground water ponds built with cement and covered on top with a thin R.C.C. slab are established in this area, to harvest the scanty annual rainfall and store it without evaporation loss. Some open wells also are used and in this case both the depth of excavation as well as the rate of pumping are carefully controlled to keep the high salinity water at lower levels from damaging crops. Almost everywhere, the irrigation is by channels (sometimes built with cement) and flooding the area of cultivation. Some fruit and olive orchards are also watered by using a can or pitcher and employing labour to do the watering periodically. The farmers in the area are by and large very poor and the Government is rightly concentrating on methods to improve their conditions. The efforts to establish more water harvesting underground tanks and wells etc., constitute the present effort.

APPROPRIATE TECHNOLOGY FOR THIS AREA:- All plant growth is optimised by maintaining root zones at field capacity and avoiding wilting of soil that causes shock to the plant. With the abundant sunshine in this tract, growing plants is only a question of water for irrigation. Particularly in porous soil conditions, flooding and furrow irrigation results in large quantities of water getting exposed to avoidable evaporation loss and even more significantly percolation to back to the water table. The biggest single constraint in this entire tract, as a result of adopting the conventional irrigation methods, is the severe restriction of the total area that can be cultivated with a given water source. Often crops suffer damage for lack of irrigation water.

Drip Irrigation technology has proved all over the world that in addition to the minimum water saving of 50% (in highly porous soil conditions, this could even be 80%), the all round plant response by way of better quality & quantity of yield as well as earlier crop maturity can bring about spectacular results. Most importantly, Drip Irrigation has been most successful even when salinity in the irrigation water is as high as 8000 p.p.m.(Abu Dhabi, Kuwait etc., add sea water to their desalinated expensive potable water to the extent of 8000 p.p.m. salts before using it for Drip Irrigation). With

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Drip Irrigation and using the present fresh water source alone, the area of cultivation can be increased 3 to 4 fold. In addition, if a technology of mixing (in a regulated way) the underground saline water to bring it within the permissible 6000 to 8000 p.p.m. (parts per mill), the total water available in this tract is enormously increased and Agriculture would then become very profitable. Fortunately in this area, there is enough annual rainfall precipitation to regularly purge and wash down any possible cumulative build up of soil salinity.

Drip Irrigation is basically the technology of establishing a network of pipes (preferably buried in the field) and through proper emitter or other alternate systems, releasing slow, regular quantities of water, only to the root zone of the plant. The design and establishment of the system is no doubt critical and important. It is certainly not beyond the capacity of trained Egyptian Extension Personnel. The system is no doubt expensive in the initial stage. But the optimised water usage, maximising outputs will more than justify the investment. If the total area of exploitation, with the same water availability, can be increased 3 to 4 fold and yields per feddan in all this area can increase anywhere from 30% to as much as 100% (based on figures quoted from most similar arid zones in the world), there can be no argument about the desperate need for this technology being extensively adopted in this entire area, almost at whatever cost.

The lining of Water harvesting underground tanks with Low Density Polythene Film, reduces seepage loss and can also result in saving in cement. The trials at Mersa Matrouh has been a step in the right direction. The excavations should be more accurately done with sides at proper right angles and straight and the walls of the pit truly vertical. This would save on heavy sand filling that damaged one of the side wall that was under construction.