APPLICATION OF EM TECHNOLOGY ON SEWAGE AND EFFLUENTS & WASTES OF INDUSTRIES NEAR MULTAN CITY

To disseminate the benefits of EM Technology to Pakistan a meeting of the founder of EM Technology, Prof. Dr. Teruo Higa, Okinawa, Japan was arranged with Gen. Pervez Musharraf, The President of Pakistan on 22nd January 2000 at Islamabad by Dr. Syed Ali, Principal Officer of EM Research Organization, Pakistan. To start with it was agreed to ascertain the efficacy of EM Technology by the Headquarter Engineers 2 Corps under "The President of Pakistan's Poverty Alleviation Program and to submit the finding complete in all respects by the end of the year 2000.

A large quantity of sewage water of many 'colonies' and effluent &wastes of industries pounded in large areas in the vicinity of village Makhdoom Rashid near Multan city. The pounded sewage and effluent waste water became stagnant and was the source of bad pungent irritating smell, breeding place for flies and mosquitoes and was the origin of malaria and stomach diseases. It was very difficult to inhale such type of stinky smell and to stand even for short period. The contaminated water had high pH, BOD, COD, TDS, TSS, Cl and S.

The Corps Commander Multan, General Muhammad Yousaf Khan, at that time ordered Headquarter Engineers 2 corps to conduct the trial on effectiveness of EM Technology in this pounded area. An investigation team comprising of Major Hafiz Muhammad Haleem as officer In charge, Naib Subedar Mr. Zafar Iqbal as field supervisor and ten soldiers as helping staff.

Before Treatment

Material and Method

As a first step the HQ Engrs. 2 crops team was introduced about the concept of EM. EM stands for effective microorganisms. EM comprises of beneficial bacteria belonging to 3 main genera: phototrophic bacteria, lactic acid bacteria and yeast. The team was made to understand that the effective microorganisms secrete beneficial substances such as vitamins, organic acids, chelated minerals and antioxidants when in contact with organic matter. Having gone through the training phase it was then planned to work and treat the sewage and industrial effluents with EM Technology. The size of the lagoon was 110 x 50 x 1.5 meter with a capacity of 8300 tons.

The pounded sewage water mixed with industrial effluent has, as said earlier, stinky smell and high pH, BOD, COD, TDS, TSS, Cl and S. The following Government institutions provided assistance in carrying out analysis of contaminated water before the start of the trial and after the completion of EM treatments:

Environmental protection Agency Laboratory,
Lahore Pak-Arab Fertilizer Pvt. Ltd.,
Multan Soil Fertility Laboratory, and
Agriculture Department, Multan.

Treatment of Sewage Water and industrial effluent

The EM extended was prepared with the following ingredients:

EM-1	=	1lit
EM-3	=	1lit
Molasses	=	3lit
Water	=	100lit

The EM extended was ready after 7 days and one liter of EM Extended was applied to 1000lit of sewage water for its treatment.

Application of EM extended

The calculated quantity of EM extended, prepared above, was injected into the waste water lagoon measuring 110m x 50m x 1.5m (m = meter) with the help of iron pipes of suitable diameter attached with tank, filled with EM extended solution, placed at an higher elevation. The wastewater in the lagoon was continuously homogenized with the help of circulatory surface aerators. This helped in getting a homogeneous mixture of EM Treated sewage water and industrial effluents and loaded with fine, medium and coarse particles of sludge on the one hand and in obtaining an accelerated reaction of effective microorganisms injected into the whole media on the other hand. The EM extended was injected on weekly basis at the rate of 2 tons per acre of sewage pond. The trial was continued for 3-month period.

Results and Discussion

At the time of beginning of this trial "Application of EM Technology on sewage water and industrial effluent and waste" the whole area was full with bad strong offensive smell, fatty flies and mosquitoes. It was difficult to breathe even, not to talk of standing for a longer period. The sewage as well as industrial effluents has been standing in this low-lying area for the last 20 years. The EM Treatment first of all showed its effect on the reduction of pungent odor and the smell was almost completely removed with in a period of 15 days. As soon as the beneficial bacteria started their habitation, multiplied in quantity and benefited the substrate by secreting organic acids, chelated minerals and antioxidants, the catalization of decomposition of organic wastes present in pounded water began with which pathogens inclusive of coli form bacteria were suppressed and their activity ceased as these were eaten by effective microorganisms. Due to which not only the stinky smell vanished but also flies and mosquitoes died. The EM made the eggs of flies infertile and further breeding was stopped altogether. Same it is true for mosquitoes. It can be safely concluded that pungent odor, flies and mosquitoes were eliminated within a 4 weeks period from such a heavily polluted sewage and industrial effluent waste water. This impact of EM Technology made the environment clean and friendly where the human beings can move happily by inhaling pure atmospheric oxygen. The EM application reduced the pH of waste water and decreased the BOD, COD, TSS and Sulphide to some extent

(Table-5.1).

The trial was conducted at Makhdoom Rashid near Multan city. The size of the pond was 110 x 50m x 1.5m (m = meter) with a capacity of 8300 tons. The pond was treated for 3 months.

#	Parameters	NEQS mg/l	Results	
			Control mg/l	+EM mg/l
1	Biochemical Oxygen Demand (BOD)	80	126	117
2	Chemical Oxygen Demand (COD)	150	294	240
3	Total Dissolved Solids	3500	2120	2680
4	Total Suspended Solids	150 l	140	30
5	Chloride	1000	500	595
6	Sulphide	1.0	20	4
7	PH	6 – 10	8.5	7.3

After Treatment

Further trials are needed to refine the data and to reach on a workable solution to make such waste water fit for irrigation purposes for various agricultural crops, improvement/ reclamation of salt affected soils of various kinds and for house hold flowering and gardening.

APPLICATION OF EM TECHNOLOGY ON AGRICULTURE AND FISH FARMING

Though the major aim was to study the impact of EM Technology on wastewater but just to satisfy one's curiosity as well as to have an idea on a large scale, EM Technology was applied to Rice & cotton crops and to rearing of fish in fishponds.

For this purpose EM extended, compost with EM and Bokashi were prepared.

Preparation of EM Extended

EM extended was prepared with following ingredients:

EM-1	=	1lit
Molasses	=	3lit
Water	=	18lit

The plastic drums were made air tight and stored in a dark room for 10 days. It was ready on 8th day for use.

Preparation of Compost

Compost was prepared with following ingredients:

Form Yard Manure	=	1ton
EM-1	=	3lit
Molasses	=	3lit
Water	=	300lit

The EM-1 & molasses were mixed well with water and a solution was formed in plastic drums. Then this solution was sprinkled over the FYM in small quantity each time and mixed well and the whole solution was sprinkled five times over the FYM and mixed thoroughly each time. Finally a heap was made and covered

with a plastic sheet to make it anaerobic. It was kept for 15 days and compost was ready for use.

Preparation of Bokashi

Bokashi was prepared by mixing well the following ingredients. First of all the solid ingredients (rice bran, rice husk and poultry manure) were mixed thoroughly and then the EM solution prepared with given ingredients was mixed thoroughly in increments, it was allowed to ferment for 15 days and it was ready for use.

1. Solid Ingredients

Rice Husk	=	100 lit (by volume)
Rice bran	=	25 lit
Poultry	=	25 lit

2. EM-Solution

EM-1	=	.3lit
Molasses	=	.3lit
Water	=	10lit

EM-Application to Rice crop

The required quantity of compost and Bokashi, prepared as given in preceding sections, for each crop and each experimental plot was weighed. It was spread over the respective area and mixed well with the upper 15cm soil layer (ploughed layer) with ploughings made for seed bed preparation. Having prepared the seed bed for rice crop, nursery was transplanted in all the treatment plots on all experimental sites. The experiment on rice crop was done at three places i.e. Flag House Multan cantonment, Abdul Hakim and Muzaffar Garh-Kot Addu. The details of locations replications, treatments and yields of nice crop are given in Table 5.2.

Table 5.2.

EFFECT OF EM TECHNOLOGY ON RICE CROP

#	Location	Replications	Treatments	Yield per acre (ton)
1	Flag House Multan	a	EM-extended EM-Compost EM-Bokashi	1.74
		b	EM-extended EM-Compost	1.48
		c	Conventional Cultivation with fertilizers	1.20
2	Abdul Hakim	a	EM-Extended EM-Compost EM-Bokashi	1.42
		b	EM-Extended EM-Compost	1.24
		c	Fertilizer	1.16
3	Muzaffar Garh Kot Addu	a	EM-Extended	0.80
		b	Fertilizer	0.50

In addition to the application of compost and Bokashi at the time of seed-bed-preparation, EM extended @ 40lit/acre/crop was also applied. The quantity of EM extended calculated for each plot and for each irrigation was simply allowed to be mixed with irrigation water by regulating the out-flow of EM extended from the container keeping in view the time required to irrigate the respective plot.

Findings

The rice crop growth was healthy and better without pests attack and faster in EM treated plots as compared to control. The number grains per spike in EM applied plots were about 10% higher as compared to control. These observations have been reflected in higher yields data of EM receiving plots than control

It is interesting to note that the application of EM extended, compost and Bokashi played its role and maximum yield at each location was obtained. This may be due to improvements made in physical conditions of the soil, which in turn improved the up-take of nutrients. The data further reveals that even the application of EM extended along with compost at both the sites gave better yield as compared to conventional fertilization.

Even EM extended applied alone at Muzaffar Garh-Kot Addu gave increased yield over conventional fertilizers.

Conclusions
It can safely be concluded that application of effective microorganisms in the form of EM extended, with compost and Bokashi does show their effect on the overall improvement of rice plant and uptake of nutrients by improving the physical properties of soil, and finally its impact on increased yield.

Application of EM to Cotton Crop
The experiment was carried out at Abdul Hakim with two replications and treatments (Table 4.3). The calculated quantity of compost and Bokashi was spread over the experimental plots and was mixed well with ploughings made while preparing seed-bed.

Table 5.3

EFFECT OF EM TECHNOLOGY ON COTTON CROP

No	Locations	Replications	Treatments	Yield/acre (ton)
1	Abdul Hakim	a	EM-extended EM-Compost EM-Bokashi	0.70
		b	Fertilizer	0.60
2		a	EM-extended EM-Compost EM-Bokashi	0.44
		b	Fertilizer	0.28

The calculated quantity of compost and Bokashi was spread over the experimental plots and was mixed well with ploughings made while preparing seedbed.

Findings
The observations were made on cotton crop at various growth stages and findings are summarized as under:

- Plant growth in EM receiving plots (EM extended + compost + Bokashi) was faster at initial stage.
- The number of branches of EM receiving plots was more by 5%.
- The number of cotton balls per EM plant was more by 15%.
- In EM receiving plots the maturity of balls was delayed.

The perusal of data given in Table-5.3 shows that the yield of cotton was increased by .10 + .16 tons per acre with the application of EM extended, compost and Bokashi as compared to conventional fertilization.

Application of EM in Fish Farming

EM extended was used to see the effect of EM applications on fish health and weight. EM extend was prepared by mixing the EM-1: molasses: water in a ratio of 1: 1: 18 and left for 10 days to have complete fermentation. At the fish-farm the EM extended was used according to the formula

EM-extended = 1lit
Fish Farm Water = 10,000lit
The EM extended was applied on weekly basis.

Findings

On the basis of observations made on various fishes the findings are given below:

- Due to initial gain in weight the fishes mature faster in EM treated water as compared to control and gave maximum yield with increased length and diameter

- Not only this but EM Fishes brought higher prices in the market due to shining good look and health.

- Spices (grass crop) of fish that feed on grass and weeds grew much larger in size by about 20 percent in EM treated fishpond as compared to normal water fishpond.

- Survival rate of fish seed was higher by 5% in EM treated water as compared to control.
  (Table-5.4).

EFFECT OF EM TECHNOLOGY ON FISH FARMING

#	Parameters considered	Control conventional method	With EM application
1	Weight of fish	1.26 kg	1.78 kg
2	Length of fish	40 cm	42.5 cm
3	Diameter of fish	30 cm	32.5 cm

Recommendations Made by the HQ Engrs.2 Crops

The trial on treatment of sewage and industrial effluent wastewater with EM was entirely carried out by the HQ Engrs 2 corps in collaboration with Principal Officer, Mr. Syed Ali. They therefore, also prepared the trial report. It could not be publicized due to the involvement of Army. Anyhow Mr. Syed Ali, Principal Officer, EMRO obtained a summary of these trials.

The Vice Chief of Army Staff Pakistan, Prof. Dr. Teruo Higa &
Principal / Executive Officer Syed Ali at GHQ R.P./Islamabad, Pakistan.

The recommendations made by the Army are reproduced as below:

* Purity/concentration of EM-1 is very difficult to ascertain and total reliance has been made on the supplier.
* Organic matter (farm yard manure) is not available with the farmer at a large scale whereas EM Technology requires a large quantity of farmyard manure.
* It is difficult to use EM for treatment of sewage waste water pounded in large areas and it, therefore, requires a lot of efforts and time to produce results.
* Trials may be conducted under the supervision of Ministry of Agriculture to confirm/ascertain its utility and model farms for various crops may be set.
* Training workshops for farmers may be arranged at administrative units (union council/district) under supervision of Ministry of Agriculture and EMRO.
- Specific grants/finances be arranged to assist and encourage farmers in creating model farms. These may be distributed through Ministry of Agriculture.