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Sewage Fed Fisheries: its Characteristics, Treatment and other Details (with pictures)

Sewage Fed Fisheries: its Characteristics, Treatment and other Details!

Increasing population industrialization and urbanisation have created problem in the form of waste disposal.

Wastes arise from virtually all form of human activities. The common means of disposal of these materials is to dump them outside the village or city limits, to burn them or to discharge them into ponds and rivers. But in recent times things have changed. Uses of waste for productive purposes have generated a new idea of waste management. Waste management deal with the methods of utilizing and recycling of all types of wastes including sanitary sewage, domestic sewage and effluents from factories and trade premises.

Sewage is universally considered as a valuable organic fertilizer as it contains abundant quantities of nutrient elements. In general way, the term sewage is used for a combined liquid waste discharged from all domestic, municipal and industrial sources within a given area. However, a more scientific and proper definition of sewage can be given as "a cloudy fluid arising out of domestic wastes containing mineral and organic matter either in solution or having particles of solid matter floating or in suspension or in colloidal or pseudo colloidal form in a dispersed state".

Imhoff et. al., (1956) differentiated between sewage and sludge. Sludge includes liquid house hold wastes from kitchen, bathrooms and laundries, but excludes facial matter and urine, whereas sewage also contains faeces and urine.

The use of sewage effluent for raising fish productivity was recognised much earlier in countries like China, Taiwan, Malaysia, Thailand and Indonesia, however in India this potentiality of sewage was noticed much later. Rearing of fish in sewage fed ponds have become very popular nowadays in West Bengal and other states like Uttar Pradesh, Madhya Pradesh, Maharashtra,' Tamil Nadu, Kerala, Karnataka and Bihar as they are utilizing sewage effluent for pisciculture.

Characteristics of sewage:

Sewage discharge of different places may vary in their chemical composition and physico-chemical nature according to dietary habit of people, composition of trade waste and water consumption of a particular place. Besides, its organic and inorganic constituents, sewage contain living bodies, especially bacteria and protozoa.

The water content of sewage may vary from 99% to 99.9%. The carbon and nitrogen ratio of sewage is around 3:1 (Klein, 1962). Sewage produced from industrial areas may have more organic carbon. Indiscriminate use of synthetic detergents in urban areas accounts for the presence o an appreciable amount of these chemicals in urban sewage discharge. Besides, carbon and nitrogen, minute quantities of zinc, copper, chromium, manganese, nickel and lead are also present in sewage. Gaseous component of sewage includes ammonia, carbon dioxide and hydrogen sulphide.

The chemical characteristics of sewage from Calcutta city, as reported by Saha et al is as follows –

PH – 6.9 to 7.3

Dissolved oxygen _ Nil

Dissolved carbon dioxide – 20 to 96 ppm

Free ammonia _ 12.0 to63.6 ppm

Albuminoid ammonia _ 1.1 to16.0 ppm

Hydrogen sulphide _ 2.4 to4.8 ppm

Phosphate – 0.12 to 14.5 ppm

Nitrite – 0 to 0.08 ppm

Nitrate – 0.01 to 0.33 ppm

Alkalinity – 170 to 490 ppm

Chloride -115 to 45Q ppm

Suspended solids – 160 to 420 ppm

Use of raw sewage to fertilize a pond for fish culture is not recommended because of its detrimental effect to fish life. The harmful effects of raw sewage on aquatic life is because of its—

(i)High biochemical oxygen demand (BOD)

(ii)Low dissolved oxygen content (Do_2)
(iii) High carbon dioxide content

(iv) High ammonia and sulphur value

(v) High bacterial load

Treatment of sewage:
Sewage in raw form can't be used directly for fish culture. It needs prior treatment, which is carried out in the following ways —

(a) Mechanical (b) Chemical (c) Biological

(a) Mechanical or Physical Treatment:
Mechanical treatment includes screening, filtration skimming and sedimentation. This help in removal of the coarse suspended particles of the sewage. For removing large sized particles screening and filtration methods are used .The particles which have the density lesser than the liquid part of the sewage normally floats on the surface. They can be removed through skimming.

The process helps in removing fats, oils, and grease and fine particles from the sewage. Sedimentation aspect deals with removal of particles of high density. For this sewage is allowed to flow at high velocity through sewage channel and then it is suddenly dropped into a large pond. This causes setting of the heavier parts at the bottom of the pond.

(b) Chemical treatment:
Chemical treatment is meant to make sewage chemically fit for t culture of fish. This can be achieved by adding certain chemicals in the sewage to neutralize its harmful effects. Different chemical methods include deodonsation, sterlization chemica precipitation and coagulation. Deodorisation of sewage can be achieved by adding chlorine and ferric chloride. Sterlization can be done by using chlorine and copper sulphate and coagulation (precipitaion) by adding coagulates like ferric chloride, lime, alum and organic polymers.

(c) Biological treatment:
Biological treatment includes oxidation of organic substances present in the sewage into carbon dioxide, water, nitrogen, sulphates and other inorganic substances by using bacteria. Bacteria decompose the substances either aerobically or anaerobically.

General method adopted to utilize sewage for fish culture:
Before releasing the sewage into fish pond it is essential to make it suitable for culture purposes. Sewage is commonly subjected to three kinds of treatments, namely sedimentation, dilution and storage.

Sedimentation:
This process is a stablization process of sewage fed water. In the essential phase of this process the settleable solids are allowed to settle down in the bottom of the sewage reservoir or sedimentation tank in order to separate solid particles from sewage. For this sewage is retained in the initial sedimentation tank for about ten days, during which a huge amount of solid particles settle down in the bottom and the dissolved organic substances present in the sewage are decomposed into inorganic nutrients like nitrates, phosphates, sulphur etc, by the micro-organisms.

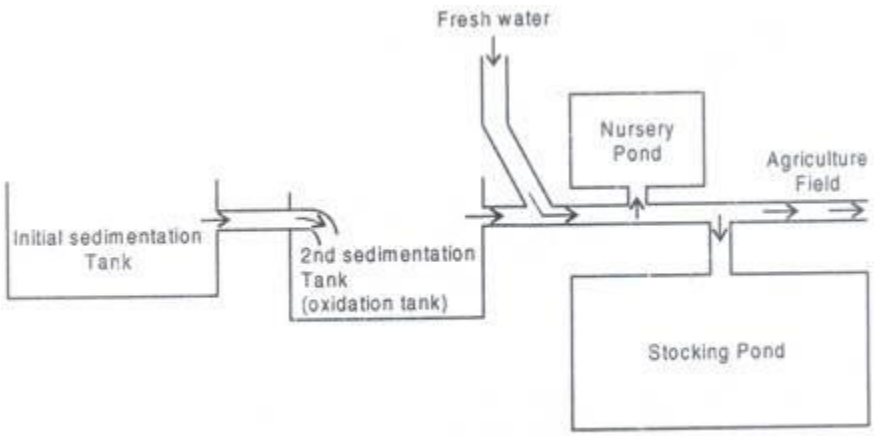

Fig. 28. Schematic representation of treated sewage supply to fish pond.

After ten days the sewage is allowed to pass into the second sedimentation tank (oxidation pond) i.e., stablising tank which is build slightly below the level of the first. The sewage flow at high velocity from first tank into second one but on reaching the second tank the velocity of flow suddenly drop down resulting in further sedimentation of the particles.

The sewage is allowed to stagnate in the second tank for about 15 to 20 days, during which despite sedimentation of solid particles, the sewage looses its foul odour and become rich in plankton flora and fauna. Algal bloom also occurs and the sewage water in stablising tank becomes enriched with oxygen and nutrients, necessary for fish culture. For a daily inflow of about one lakh litres of sewage a sedimentation pond of 50 x 20 x 1.5 metres is recommended.

Dilution:

Even after sedimentation the sewage water may not be suitable for fish culture because of low oxygen content and high carbon dioxide, ammonia, hydrogen sulphide etc. level. So before releasing the sewage water of the stablising tank (second tank) into nursery or stocking ponds the sewage is subjected to dilution by fresh water. Fresh water is mixed with the sewage water of the second stablising tank through an over flow channel.

The dilution ratio practiced in different parts of the country may differ from each other, however in general sewage water and fresh water ratio used is 1:4.5 or 1:5. Dilutions brings down the Co_2, NH_2, and H_2S below the lethal limits and restore the dissolved oxygen level for the proper growth of producers as well as for fish development.

Storage:

The composite water dilution are discharged into nursery pond meant for the rearing of fish fry through a channel and also, into stocking pond meant for development of fish above fingerling stage. Such stored water contains relatively more fertilizers and nutrients for fish growth as compared to the water which is devoid of sewage effluents.

Fish culture in sewage fed ponds in India:

For fish culture sewage water of stablizing tank as well as the water after dilution can be utilized. Air breathing fishes are more suitable to be cultured in sewage treatment ponds as they can survive in water with lesser dissolved oxygen content. The fish like Clarias

batrachus, Heteropneustes fossalis, Channa spp., Tilapia mossambicus and Ctenopharyngodon idella (grass carp) are the species of choice to be considered for culture in sewage treated ponds.

The species of Tilapia have proved to be most suited for culture in sewage irrigated ponds. They have lesser demand of dissolved oxygen and are able to survive at high ammonical nitrogen level of 5.43 ppm. They grow and breed freely in sewage ponds so profusely that to keep their population under control either monosex culture of Tilapia or a polyculture along with Clarias have been recommended for obtaining higher yield. Ghosh et. Al., (1976) reported a total production of 220 kg/hectare in a composite culture of Tilapia and Clarias.

Carps, being very sensitive to low dissolved oxygen (DO) content, can't survive in sewage stablizing tanks. They are thus, raised in ponds receiving dilute sewage water. An average production of six tonnes of carps per hectare has been achieved from treated sewage fed water ponds. The stocking density in sewage fed water is always higher in comparison to normal fish farm ponds.

In sewage fed water the stocking density of Cirrhinus mrigala can be 10,000 per hectare, against 5000 per hectare in ordinary non-sewage fed fresh water ponds. In polyculture observation conducted by state government in sewage fed farms near Calcutta, the fingerlings of rohu, catla and mrigala of 7.5 cm length stocked in a ratio of 1:1:1 @ 550 kg/ha gave an annual fish production of 3237 kg/ha. Best results were obtained when stocking ratio of rohu, catla and mrigala was 1:2:1.

There are several other recommendations about stocking ratio of different species of carps raised in sewage fed ponds, such as-

(i) Silver carp, catla, rohu, mrigala, common carp and grass carp in a ratio of 25 : 15 : 10 : 25 : 20 : 5.

(ii) Catla, rohu, mrigala, common carp and scale carp in a ratio of 40: 10: 20: 20: 10.

Air breathing fishes like Clarias batrachus, Heteropneustes fossalis, Murrels (Channa) can also be reared along with carps, but owing to their predatory habits these fishes should be introduced into the pond only after the fingerlings of the carps have attained a considerable size.

Growth rate in sewage fed ponds of carps of different species in compesite culture is variable. Ghosh et. al., (1973) reported that growth rate of silver carps raised in sewage fed pond is always more than other species. Silver carp attains an average weight of one kilogram in 3 months while its counterpart's rohu, catla and mrigala weigh only 200 grams in the same period. Since, silver carp is a phytoplankton feeder the huge production of phytoplankton's in sewage fertilized ponds is maximally utilized by this fish.

In this way, sewage fed fisheries is a new venture for India. Fish culture in sewage system involves little investment with higher yield. A sewage fed pond does not require fertilizers and supplemented food. This reduces the cost of culture and at the same time the growth rate of fish in such ponds is also faster. Unfortunately, in India the practice of sewage culture of fish is not very popular. There are only about 132 sewage fish farms covering an area of about 12000 hectares in India.

Its commercial utilisation has been undertaken by West-Bengal Govt. only. The general view that a fish grown in sewage tanks contains large number of bacteria in their body or are bacterial infected fish is ridicules as observations have proved that they are like other fish grown in fresh water ponds. Rather, the fish produced in sewage fed ponds have better taste then fresh water reared fish. The water of the sewage fed ponds, after fish harvesting can be utilized for irrigation purposes with a dual purpose of irrigation and fertilizing the field.