

Fukui Bio-Cord Reactor

What is Bio-Cord?

Bio-cord was developed for drain off management using microbe activities to prevent water pollution in oceans, rivers, lakes, and marshes. Bio-Cord is the result of Japanese technical know-how and biotechnology. At present, the drainage of the polluted water from factories and houses is becoming an increasingly large social problem, and this development of ecological products is receiving high interest from various commercial industries.

Excerpt from IIRC NEWS October/December 1994

In Japan where greater and greater numbers of people flock to the cities, the amount of sewage flowing into rivers and bays is causing serious environmental problems threatening not only those immediate areas, but also the whole nation. While there are many proposals on how to treat sewage, a new method has emerged which has been attracting the attention of local governments all over the country. The Bio-Cord system was developed by TBR Co., Ltd., a rope and cord manufacturer, and uses a type of cord specially developed for purifying water.

Glancing at this cord, you might think that the probabilities of success are very unrealistic. Each cord is simply made up of a core strand covered with numberless rings of thread. The thread is made of polymer such as poly (vinylidene chloride) and polypropylene thread. In appearance, it resembles a fantastically long tangle of thread covered in loops. When in use, 10 m lengths of the cord are stretched between pairs of poles, spaced 10 cm apart. These poles are planted on a riverbed so that the cords are underwater. The total number of cords to be used varies with the width and depth of the river. More than one system may be set.

When the Bio-Cord is submerged in water, microbes adhere to the threads and multiply there to decompose organic substances (e.g., proteins and sugars) in sewage. In the natural state, rivers have sufficient hydrophytes and microorganisms to cleanse the water of organism contamination at normal levels. However, they are unable to cope with large quantities of contaminant, and also become less efficient when the surface area of the riverbed is reduced by flattening it and covering it with concrete. The objective of Bio-Cord is to supplement the river's inherent ability.

At first it might seem to be a matter of chance that bacteria will adhere to Bio-Cord, however, the thread rings have a positive charge in the water and the microbe cells are negatively charged. As a result, the microbes are attracted to and held by the threads. In addition to this, bacteria are divided into two types, aerobic and anaerobic, according to their preference for air. The intricate Bio-Cord prevents dissolved oxygen from reaching the cored center, where anaerobes prevail. On the other hand, aerobes multiply in the outer part.

Bio-Cord thus provides a symbiotic culture bed for a wide spectrum of microbes including bacteria, protozoans, and algae. The proliferating microbes efficiently treat the sewage, and ensure a high quality of treated water. In one case, the Bio-Cord system proved able to cleanse a river so well that the biological oxygen demand fell approximately 29% from 76 ppm to 54 ppm.

Anaerobes consume the excreta of the aerobes, so the system becomes a balanced food chain in itself, and produces less excess sludge than other systems. The simple Bio-Cord system requires little maintenance, and is easy to install. The polypropylene loses one-half its strength when used for five years only because of ultraviolet radiation, whereas thread made of other material is unlikely to degrade unless some external force is applied.

TBR Co., Ltd. manufactures a variety of ropes and braids from sturdy fishery ropes to the supple lift cords of Venetian blinds. The concept of the Bio-Cord system came about from an oyster farmer's observation that seawater became clear when the company's ropes with branch strands were used in oyster beds. TBR might be most qualified to develop the suggestion to the product in such a simple and feasible form, because the company has long been acquainted with cords and ropes and is experienced in finding the best material for any product.

Bio-Cord has been recognized as a promising water treatment tool, and is working in medium and small size rivers all over Japan, especially those in central Japan, where the company is based. The success of the company is an object lesson in how to develop commodities.

Bio-Cord is the choice material for microorganisms to grow on for a number of reasons:

- Bio-Cord has a positive charge and when placed in water attracts microbes which by nature have a slightly negative charge.
- Its large surface area and space make it an ideal environment and dwelling for many different kinds of microorganisms.
- The contact material is made of small fibers therefore bacteria attach to its surface easily.
- The structure of Bio-Cord and even ring of strands of cord around a central core, give bacteria the best conditions in which to multiply, both at the surface and interior of the cord.

Distinctive Features of Bio-Cord.

Polyvinylidene chloride, one type of raw material for Bio-Cord, is physically and chemically stable and, as a result, Bio-Cord's endurance is high. The weight of the cord is well suited to float in water with the gathering bacteria groups. The rigidity of the cord is suited to produce even lengths of strands coming out from the middle cord.

1. Bio-Cord treatment makes water cleaner and reduces odor.
2. Elimination rate using Bio-Cord treatment
 - BOD less than 10 ppm -----> more than 95%
 - T-N less than 10 ppm -----> more than 85%
 - T-P less than 1.0 ppm -----> more than 60%
3. Bio-Cord is designed to adapt to quality or volume changes of the water.
4. Bacteria absorbs the by-product of other bacteria thus producing a food chain which reduces the amount of waste produced.
5. The superior microorganisms multiply and eliminate phosphorus.

Distinctive features of Water Treatment System Using Bio-Cord

- Superior microorganisms grow faster on the bio membrane than with using the activated sludge method. Therefore, this method can makes the food chain longer and creates less mud (waste). This feature of Bio-Cord makes it more economical.
- Bio-Cord is the choice material for bacteria, microorganisms, and primeval creatures to grow on. By using Bio-Cord these things can co-exist therefore the cord has a higher efficiency, quality and can better adapt to a change in water volume, density or quality.
- In a properly engineered system cleaning of the Bio-Cord isn't required as often therefore you can have water treatment that is more stable.
- The increased amount of surface area holds a larger quantity of microorganisms per unit length compared to other bio-reactor media. This means that less area is taken up by the bio-reactor.

Bio-Cord Usage

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| 1. | Daily Public: | Farm Villages, Office Buildings, Schools, Filtering Plants, Towns, Homes |
| 2. | Public Institutions: | Highway Service Areas, Athletic Parks, School Lunch Centers |
| 3. | Stock-raising: | Pigs, Cattle Ranches, Zoos |
| 4. | Food Factories: | Breweries, Fisheries, Dairies, Snack Foods |
| 5. | Public Eating Places: | Restaurants, Hotels, Fast Food Shops |
| 6. | De-odorizing Machines: | Food Factories, Waste treatment plants |
| 7. | Water Filtering System: | Homes, Apartments |
| 8. | Recycling Water Plants: | Homes, buildings, factories |
| 9. | Fisheries: | Freshwater, Salt Water, Recycling System |
| 10. | Factory Recycling water: | Cooling, filtering system |
| 11. | Swimming Pool: | Filtering and elimination of NH_3N |
| 12. | Cleaning Rivers and Lakes: | Added to the current eliminating N and P |
| 13. | Pre-treatment of Drinking Water: | Cleaning the water supply |

Other Applications of Bio-Cord

1. When pollution in the rivers exceeds the rivers' natural ability to cleanse the water, Bio-Cord is deployed horizontally on the riverbed becoming a dwelling for microorganisms where they live and multiply. The aim of this method is to reduce the flow sludge loading. This principle is based on the self purification that rivers have naturally.
2. Bio-Cord can be used to eliminate the plankton in a red tide.
3. Bio-Cord can be used as a fish reef as well as a substrate for young abalone to attach to.
4. In construction applications Bio-Cord will prevent the dirt and sand from polluting the water by catching the particles in the countless rings that make up the cord.
5. The cord can also filter small materials such as starch out of water. This would be useful in the food or chemical industry.
6. It can be used for compact water recycling systems on boats or ships.
7. Due to the flexibility of Bio-Cord it can be placed in a pipe or other piece of equipment that has a complex shape.

Material & Form

Bio-cord is available in a variety of synthetic fibers such as polypropylene, vinylon, polyviylidene-chloride, binylon, nylon and tetron (polyester) with sizes ranging from 25mm to 45mm. The type used depends on the BOD (biological oxygen demand), suspended solids and end use.

Excerpt from JETRO, August 1990

Microorganism Cord Support for Clarifying Waste Water

TBR Corp. has developed a microorganism cord support useful in wastewater clarification by the bio-filter bed immersion method.

Called "Biocord," it is formed with a large number of looped threads that extend radially. Consequently, microorganisms easily adhere to the cord and multiply there. In addition, the microorganism floc is not easily washed away from the cord.

Of the many waste water clarifying methods, the biological process is widely used for clarifying organic waste water such as sewage. As is well known, the activated sludge process is the core technology of organic wastewater clarification. The process, however, has been little improved for long time.

The bio-filter bed immersion method is therefore noteworthy as it meets many present demands in current waste water clarification: easy maintenance and management, less sludge production, and effective clarification of waste water containing resistant or unusual organic substances.

Because the performance of the bio-filter immersion methods depends greatly on the nature of the filter, it was desirable to develop a microorganism carrier with excellent characteristics.

The new product can hold microorganism flocs of many types in bulk, and can extensively clarify waste water with symbiotic microorganisms in an ideal environment. In particular, aerobic and anaerobic bacteria can coexist in the cord by holding a larger quantity of microorganisms for its unit length, the cord enables disposal vessels to be made smaller.

The flexible cord adopts any form when installed, so that it is applicable to vessels and equipment of any configuration and structure, cleaning and repair are easily conducted if necessary.

The Bio-Cord will be offered at the same or lower price than other viable filters or contact members.

Excerpt from JETRO, July 1994

Cord Type Contact Material Biocord

TBR Co., Ltd., a manufacturer of braided cords, has developed a cord type contact material Bio Cord that is attracting the attention of autonomous entities throughout the country.

Bio Cord enables rivers to be purified naturally without using chemicals. In autumn last year, the Bio Cord was installed at seven spots in Sakai River, a tributary of the Nagara River (Gifu Prefecture), and will be installed in the tributaries of the Shimanto River (Kochi Prefecture).

Bio Cord is a special type of long rope that serves as the central core, from which numerous rings of fine threads made of vinylon or polypropylene extend radially. The rings are produced by a special process and is charged with positive ions which absorb negative ions actively, so it can culture a broad range of microbes in a good environment, such as bacteria, metazoa, microcreatures and microalgae, and displays an excellent waste water treatment effect and suppresses the generation of sludge. Because of this shape, it is possible for aerobic bacteria and facultative anaerobic bacteria to live together.

This rope is cut into 10-m segments, and 40-50 of these segments are wound on a fixation iron bar a 10-cm spacing, then placed in the river. Bacteria adhere to the threads after 2-3 days, so Bio-cord decomposes organic substances in sewage water.

A Bio Cord 100m long has decreased the biological demand (BOD), which indicated the degree of contamination, by about 20-30% in a month.

The company manufactures fishing ropes, but realizing that river contamination is the cause of oceanic pollution, made experiments on various materials based on the company's knowledge of ropes and ultimately succeeded in developing Bio Cord. The company is using a high-strength vinylidene-chloride Bio Cord for treating wastewater generated by agricultural villages.

Bio Cord (only polypropylene) loses one-half of its strength when used for about 5 years, but is not deteriorated by factors other than ultraviolet radiation. When used for a long time, fallen leaves and other foreign matter may be caught and impair the appearance, but it generates no offensive odor.

The company is also undertaking Bio Cord installation, and removes vinyl packages, empty cans, and rubbish entangled on Bio Cord.

BIO-CORD TECHNICAL SPECIFICATIONS

NAME	BC-1	BC-2	BC-3	BC-4	BC-6
MATERIAL	Polypropylene	Vinyon & Polypropylene	Polyvinylidene - Chloride	Binylon	Nylon & Tetron
COLOUR	White	Brown & White	Blue	Brown	White
OVERALL DIAMETER	45mm	45mm	45mm	45mm	25mm
ROPE CORE DIAMETER	5mm	5mm	5mm	5mm	3mm
WEIGHT	3.4 kg/100m	3.4 kg/100m	5.5 kg/100m	3.3kg/100m	1.6kg/100m
SURFACE AREA	2.8m ² /m	1.63 m ² /m	1.42 m ² /m	0.55 m ² /m	0.42 m ² /m
BREAKING STRENGTH	74 kg	74 kg	74 kg	74 kg	60 kg

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