

- Invited Paper -

HISTORY AND STATUS OF MARINE AQUACULTURE FACILITY DEVELOPMENT IN JAPAN

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Marine fish culture of Japan has its origin in yellowtail culture which began at 1927 in Kagawa Prefecture, and it was embankment style which partitions the fixed sea area between creek or island and island. In 1958, net partition style facilities was developed which was the cheaper and less constraint in the design. It is a system that the net partition style supports the net by props and floats such as the concrete pile and that it divides the sea surface, and the former is called the prop style, and the latter is called a suspended pattern. In the meantime, the culture of net cage style was developed by Fisheries Laboratory of Kinki University since 1954, with those as a momentum, difficulty of transfer of the place when fish are harvested, and its expensiveness. This adopted net cage to it only for the transient cultivation as a fish facility. This method rapidly spread since then, and has been established as a general fish culture method until now.

Everyone was able to manage net cage in the beginning in little capital which used netting made of the coir or cotton yarn, frame bodies of net cage which combined wood or bamboos, etc. and sandbags and anchors, etc. as a mooring ingredient. Therefore, such cages were set at the limited installation sites of bay inner part and island negatives from the workability and safety with small effects of wind wave. However, the aquatic environment as bay inner part generally deteriorated by drainage pollution which increases with economic development and aquaculture pollution which the overpopulated culture brings about. In the meantime, because of increased culture output and stagnation of the market price by the increase in imported food quantity and of various costs, the fish culture management after 1980's began to become severe, and the reduction in the production cost by the rationalization would be required. As the result, the size of net cage gradually enlarged, whose 1 edge of 7m in the beginning, and the culture farm with large capital force gradually moved to the mouth of bay division. And, from fish culture form of completely devoted to yellowtail culture whose profitability lowered, attempting the diversification of fish species including red sea bream for example has been made.

Chemistry and engineering technology which developed with needs from such background and economic growth enabled to develop or import net cage whose netting made of various chemical fibers or wire netting and frame of various materials one after another. These

materials are respectively chosen by the environments, fish species, size of the fish, safety, workability and cost of the installation site, etc., and the combination is devised.

The structure for supporting the upper end of the net cage on sea surface can be classified into 3 types of (1) frame support system in which floats support the small buoyancy frame body, (2) floating body support frame system in which the frame itself serves as a floating body, and (3) combination float system (the float style) composing only of float and rope.

In float support system, square frame whose 1 edge to is smaller than 12m is generally used. Material of frame is generally galvanized steel which spread from 1975 ages, and hard rubber coated steel pipe, FRP and wood are also used. Larger frame has a round shape, and it becomes made of galvanized steel pipe, H class or made of the rod class, and its largest diameter is 40m. Still, larger (1) type frame has decreased because the price per unit area rises in comparison with (2) and (3). Cheap styrene foam is used as float material in many cases, however, the resin covering float of which the durability is high is spreading although it is expensive, since the disposal becomes difficult because of the dioxin pollution. There is some an example of using the pressureproof resin float in order to subside and levitate net cage by the note discharge of the air, under the ocean environment.

In type (2), the pipe which made high density polyethylene (H.D.P), FRP, high-intense rubber, etc. to be a material is used. H.D.P frame is imported from Norway and Australia, and the square cage of 20 m one edge and a round shape in larger ones (50 m in diameter largest). The largest frame used in Japan has maximum size of 35 m in diameter. This frame is more resistant to the ocean wave, excellent in the durability, easier in assembly, and cheaper, especially in large facility, in comparing with type (1) frame, it is spreading in large-scale culture or tuna culture at present.

Type (3) frame, because it is most resistant to ocean wave and of low cost, is mainly used in large-scale tuna culture, however, use is little in net cage of small and medium size, since workability in the shipment and selection is low.

Present material of netting can be classified into wire and chemical fiber roughly, and there is some an example in which both are used by combining. Material of chemical fiber net introduced firstly was vinyl chlorides, vinylidene chloride, nylon, etc., however, the degradation by the ultraviolet ray was intense in these. The polyethylene net with strength and durability was not developed until around 1970. Although multifilament thread is generally used for netting, the tortoise shell netting made of monofilament thread, though difficult to be handled, is used in the place where the tidal current is rapid, because the netting stretches well. The zinc coated wire was used from 1972 ages as the material of netting, and it spread from 1980's, because of its parasite antagonistic effect. However, its service life is short from the corrosion by sea water, and largest defect is that the waste disposal is difficult. Then, development and test culture of nonferrous metal wires such as titanium, aluminum, cupro-nickel are carried out at present.

In the medium-scale culture farm, it is general that large number of net cage are coupled and fixed the four quarters directly by anchors and sandbags. There are facilities adopting single point mooring style which connects net cages by fixed with one concrete lump. In addition, there is the square tension rope system fixed in concrete lumps in the four quarters, which make the netting stretch. The net cage frame is connected with ropes between its four corners and the intersection point of the tension rope. This type of net cage is adopted as joint use facilities of multiple and small-scale culture farm and as facilities of large-scale culture farm.