COMPATIBILITY OF OPEN CAGE NET PENS WITH ORGANIC AQUACULTURE STANDARDS

USE OF ANTIFOULING IN THE CHILEAN SALMON FARMING INDUSTRY

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Abstract

This paper gives information about a survey carried out through the project FIP 2003-08 to obtain information about the volume and types of antifouling used by the salmon farming industry in Chile. The study was based on a questionnaire applied to the seven companies that distributed antifouling paint to the industry during the period of the study (1999-2003). Results of this research showed that the salmon industry used 8.41 L of antifouling per ton. of salmon produced in 2003. In contrast to Europe and North America, 88.6% of the all aquaculture net coatings sold in Chile in 2003 were based in volatile solvents and only 1.4% was waterbase.

Introduction

The salmon farming in Chile started at the beginning of 1980's and to date is one of the most successful activities into the Chilean economy. Chile has been the second largest salmon producer in the world since 1992 with incomes of US$ 2,207,000 (387,000 ton exported) in 2006. The Region X (42°LS) produces 84% of the total salmon in Chile. Since of the origin of the salmon industry in Chile, only one company was involved in the production of organic salmon, between 2002 to 2005, however it was canceled this kind of production after the company was buying by other company.

One of the main technical problems which affect to salmon farming in Chile is the fouling in the on-growing phase at the sea. The composition and seasonality of fouling depends on environmental factors such as temperature, light, salinity, tides and transparency amongst others. The fouling in the salmon farm net pens can cause detrimental effects, including decreasing the water flow through the meshes; the clogging of mesh and the addition of excess weight. Consequently fouling can reduce water flow through the nets by 30-40% (Willoughby, 1999). Also, the effect of fouling on floating structures and nets could increase the diameter of the net twine by four-fold (Beveridge, 1991). It has a direct effect on the health of the fish by reducing the oxygen levels and increasing fish wastes and ammonia levels in the water. Additionally, the attached organisms can act as vector of pathogens with serious consequences for the health of fish reared into the cages.

Copper is the only metal allowed to be used in antifouling paints for fish farming nets in Chile. Copper is defined as an environmental toxin and has been shown to accumulate in various organisms such as algae, oyster, mussels and crabs (Willoughby, 1999). The principle underlying the use of antifouling composition is that the biocides which they contain slowly and constantly dissolve to provide a surface permanently surrounded by a thin layer of toxic solution. The dissolution process which removes the biocide is

termed “leaching” and the rate of removal is the leaching rate. An effective copper based antifouling releases copper at about 10 to 20 micrograms/sq. cm/day (Lovegrove, 1979).

This paper gives information about the amount and types of antifouling paints used by the Chilean salmon industry in the period 1999-2003. The study was based on a questionnaire submitted to the seven companies which distributed antifouling paint to the salmon industry during the period of study and also to the 20 companies which give services of antifouling net impregnation.

In the Region X there are several farms which are not using net coating, in order to minimize the impact on the environment, however there is not official information about what is the proportion respect to the total of the salmon industry. Table 1 shows information about the period of protection of the nets against fouling, in nets with antifouling coatings in comparison with nets without antifouling paints.

Table 1: Period of protection against fouling in antifouling coating nets v/s without antifouling coating.

	Autumn - Winter		**Spring - Summer**	
Size mesh	**With antifouling**	**Without antifouling**	**With antifouling**	**Without antifouling**
Smolt 1"-11/4"	16-24 weeks	4-6 weeks	13-21 weeks	10-20 days
On-growing 11/2"-21/4"	16-32 weeks	4-7 weeks	17-26 weeks	15-20 days

Source: Atared

Methodology

The information was collected over a period of five years (1999-2003). The amount of antifouling used by the Chilean salmon farming was obtained through a questionnaire applied to the seven companies which selling antifouling paint in Chile (Table 2). The questionnaire was submitted to a contact person within each company by e-mail and post, and replies were collected in the same way, with individual follow-up for clarification as appropriate. Information requested was characteristics of the antifouling; component of the antifouling and the amount sold for the years 1999-2003. The questionnaire was also submitted to the 20 companies which give services of antifouling net impregnation to the salmon industry.

Results

In the period of study 10 types of antifouling paints were identified for sale by the seven companies, four of them waterbase and the other six based on volatile solvents (Table 2). The biocide used in all antifouling products was copper oxide which was present in a concentration of 10% to 30%, according to the product, while the total solids reported was among 42% to 67% (Table 3). The antifouling solvent based use as solvents, xylol, white spirit and, petroleum, while the antifouling water based use water as solvent.

Table 2: Antifouling supplied to the Chilean market during the period 1999-2003.

Product	Characteristics	Saler	Producer
Flexgard	solvent based	Aqua Cards	Flexabar Aquatech Co.
	waterbase		
Hempanet 7150 A	solvent based	Kupfer	Pinturas Hempel
Norimp 2000	solvent based	Ceresita	Jotun-Henry Clark Ltda
B 04464 Q	solvent based	Sherwin Williams	Sherwin Williams
Aquasafe	solvent based	Equipos Industriales	Gjoco Industrier AS
	waterbase		
Netguard	solvent based	Bayer	Sten-Hansen Maling AS
Aquanet	waterbase		
Netrex*	waterbase	Akva Chile	NetKem AS

Tabla 3: Characteristics of the antifouling paints marketed in Chile (1999-2003)

Product	Solvents	Active Ingredient	Binder	Specific gravity (g/cm^3)	Total Solids (%)	(%) Copper
Aquasafe	xylol white spirit	copper oxide	natural gum resin	1,27	45	15-25
Aquasafe-W	water	copper oxide	acrylic / wax emulsion	1,27	54	15-30
Aqua-Net	water	copper oxide	Acrylic	1,34	42- 50	10-30
Net-Guard	white spirit xylol	copper oxide	sintetic resin	1,22	48-55	10-30
Norimp 2000	white spirit xylol	copper oxide	Colophony	1.2 – 1.4	57 ± 2	10–20
Hempanet 7150 A	xylol white spirit	copper oxide	Colophony	1.35 ± 0.1	50	10-15
Flexgard	white spirit	copper oxide	natural gum resin	1.5ó – 1.56	67 ± 5	15-20
Flexgard	water	copper oxide		1.45 -1.49	55	10-15
Netrex	water	copper oxide	wax emulsion	1,15- 1,20		10-20
B 04464 Q	white spirit	copper oxide	Colophony	1,2 ± 0,02	59 ± 2	

In 1999 the seven companies recorded sales of 1,760,000 L of antifouling paint for the salmon industry, 3.4% of them water based, while in 2003 was recorded an increase of 265.5% with 4,672,886 L sold for this year, where the11.4% was waterbase (Table 4; Fig.1).

Table 4: Relation of antifouling sold for the Chilean salmon farming v/s salmon production (1999-2003).

Year	Antifouling (L)			% Increase (L)	Salmon Production (Ton)	% Increase Production	**Relation L/Ton**
	Solvent Base	Water Base	Total (L)				
1999	1,760,000	0	1.760.000		230.159		***7,65***
2000	3,174,000	0	3.174.000	80,3%	342.406	48,8%	***9,27***
2001	2,942,000	102	3.044.000	-4,1%	504.422	47,3%	***6,03***
2002	3,039,033	87,694	3.126.727	2,7%	482.392	-4,4%	***6,48***
2003	4,137,929	534,957	4.672.886	49,4%	486.837	0,9%	***9,60***

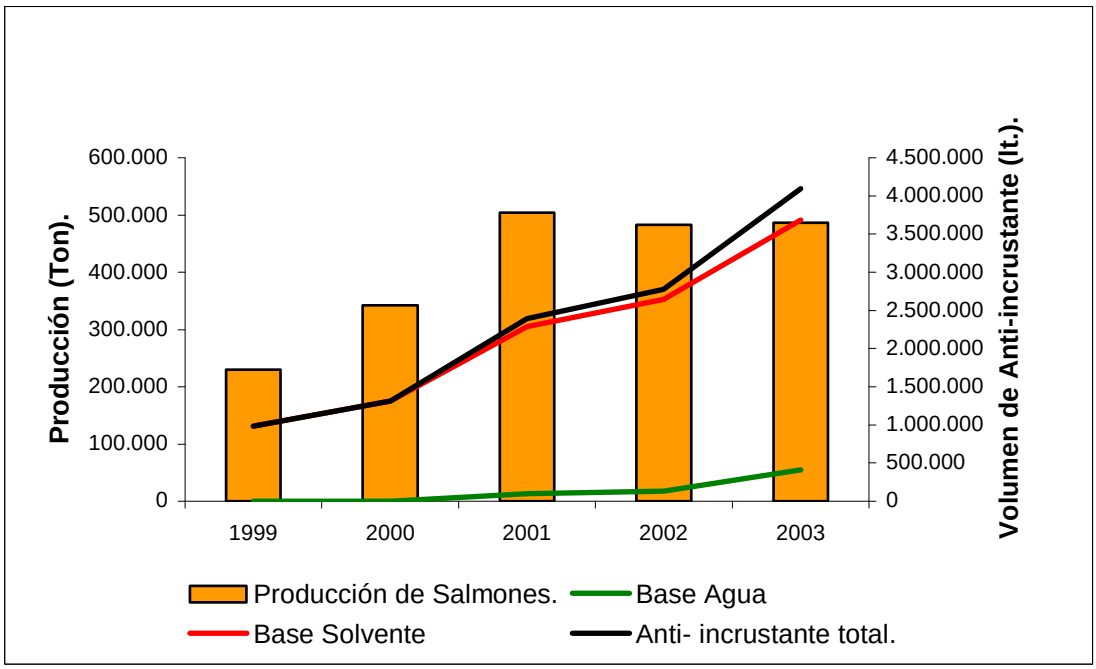

Figure 1: Salmon production v/s antifouling used by the salmon farming in Chile (1999-2003)

According to the results obtained through the survey, 4,672,886 L of antifouling were sold in 2003 for a production of 486,837 ton. of salmon (Table 4). The relation among volume of antifouling marketed per ton. of salmon produced in 1999 was 7.65 L/ ton, while in 2003 this relation increased to 9.6 L/ton., showing an increase of about 25,5 % in the period of study (Table 4). Fig. 2 shows the increase in the volume of antifouling sold in the period of study in relation to the growth in volume of salmon production in Chile.

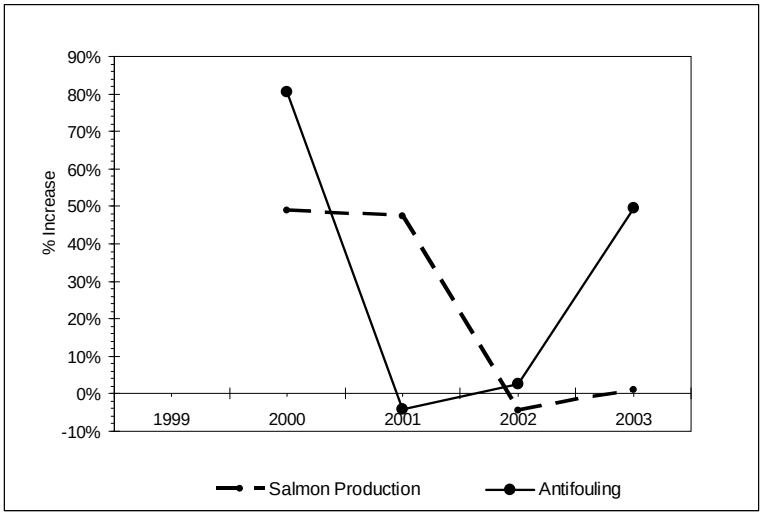

Figure 2: Evolution in the use of antifouling by the Chilean salmon industry v/s the salmon production (1999-2003)

Discussion

The increase in the use of antifouling paints shown through the years (Fig. 2) is a consequence of both the increase of the net cages size and also the location of the cages in open sites which make it difficult to service the changing of nets. The frequency of use of the net coating depends mainly on the environmental conditions and particular characteristics of the site. Considering that the period of protection of the antifouling in summer is about 5 months and 6 months in winter, most of the farmers stock the smolts in impregnated net with size mesh of 1 inch and just change the net when the fouling has taken place, replaced with impregnated net of size mesh of 2 inch. The fish are then kept in this net until attaining harvest size. Once the antifouling is leached the nets are quickly invaded by fouling which, besides seaweed, includes larvae of mollusks, mussels and other organisms.

In comparison with Europe and North America, only 10% of the antifouling used by the salmon industry in Chile is water based. The main reason argue by the industry is the fact that the waterbase coatings need to dry completely before deployment at the sites. This requires a specific type of installation and not all facilities which offer net impregnation services have implemented. The solvent base net treatment has a 90% market share in Chile because of the easy drying by solvent evaporation. However, this situation should change in a short time considering the more severe impact of the formulations based in volatile solvents on the environment and human health.

As in other countries, and because of environmental concerns over the use of toxic metal other kinds of solution to remove the fouling of the net have been evaluated in Chile, including several washers (disks, brushes and high pressure) operated by workers from the side of the cage, either from the surface or by divers. However these methods have not been shown to be a good solution because the material in suspension around the cages also causes gill obstruction and adverse effects on the environment. In addition, the location of farms in open sites makes this a difficult operation.

There are several farms in the Region X which in the last years are not using antifouling coatings to minimize the impact on the environment. In this case, nets are changing every 20 days in summer and in winter with a frequency of 2 months. There is not documented information about the impact of the major frequency in the change of nets over the outbreak of diseases or welfare of fish, neither about the effects on the risks of escape fish or over the predators. However, the frequent handling of the nets can to bring risks of diseases and poor welfare for the fish if are not doing in a suitable way.

The use of copper base paints in Chile will be banned once an acceptable alternative is found, but at the moment the antifouling copper based products are less hazardous compared with TBT which has been shown to be about 1000 times more toxic than copper of the same concentration (Wallace, 1993). Until now, and as in other countries, the regulations in Chile about the use of antifouling are focused on the development of a Best Management Practices Plan to minimize the impact on the environment.

The regulations implemented In Chile does not permitted the use of antifouling in net cages located in lakes (fresh water). Also, it is not permitted to wash the nets onshore to avoid the copper being further deposited into the marine environment. Nets must be washed in suitable facilities where the waste water can be treated to reduce the level of copper prior to release to the environment. The maximum level of copper allowed in waste water discharged into the marine environment in Chile is 1 mg/L (D.S. Nº90). Apart from the regulation for the liquid wastes there are regulations for the solids wastes. The wet percentage in solid wastes (mud) is among 50% to 90%, which depends of the type of wastes and the extraction method. The regulations indicate that the solids must be treated to reduce the amount of water to 30% or less, and in this way it can be discharged in authorized sites. The percentage of copper in the solids must be 1% to 10% (FDI 01CR3PT-04).

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