TRATTAMENTO, STOCCAGGIO E POSSIBILE RIUTILIZZO DEI SOLIDI SOSPESI PRESENTI NEI REFLUI DEGLI IMPIANTI DI ACQUACOLTURA INTENSIVA A TERRA

TREATMENT, DISPOSAL AND POSSIBLE REUSE OF SUSPENDED SOLIDS IN THE EFFLENT OF INTENSIVE LAND-BASED FISH FARMS

V. ZONNO, P. MARRA, G. DE NIGRIS*, C. STORELLI and S. VILELLA
Dipartimento di Biologia, Università degli Studi di Lecce, Italia
* Ittica Ugento S.p.a., Lecce, Italia

INTRODUCTION

Well standardised intensive land-based fish farming is an increasing source of pollution due basically to dejection and uneaten food present under the form of suspended solids (Fig. 1).
Suspended solids (SS) in the effluents are very difficult to estimate considering only production output; their quantity and quality depends on:
- feed quantity
- feed quality
- feeding methods
- water renewal rate
- tank hydrology
- fish density

In order to find out a technical, economical and environmentally friendly solution to this problem, either for fresh and seawater, 3 EU Universities and 4 SMEs (Fig. 2) have been involved in a CRAFT project (contract FAIR 98-9110) studying and defining applicable techniques for the different aspect of the new technologies to be employed. In particular, in this paper results obtained for the marine effluent treatment are shown.

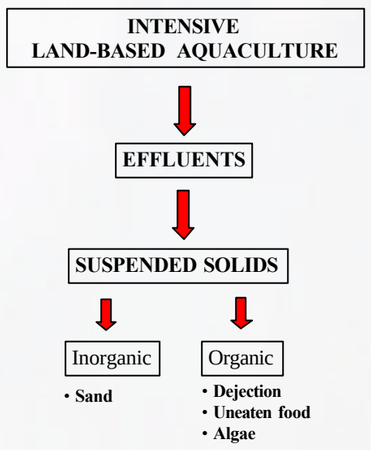


Figure 1

OBJECTIVES

Industrial/economic:
- EFFLUENT FILTRATION
- THICKENING OF ORGANIC MATTER
- CHARACTERISATION OF WASTE
- WASTE STABILISATION AND STOCKING
- IDENTIFICATION OF POSSIBLE REUSE, INCLUDING SALTY WASTE

Social/environmental:
- REDUCTION OF ENVIRONMENTAL POLLUTION
- COVER THE COST OF INVESTEMENT AND MAINTEANCE
- RECYCLING PART OF THE ENERGY CONTENT OF AQUACULTURE SEWAGE

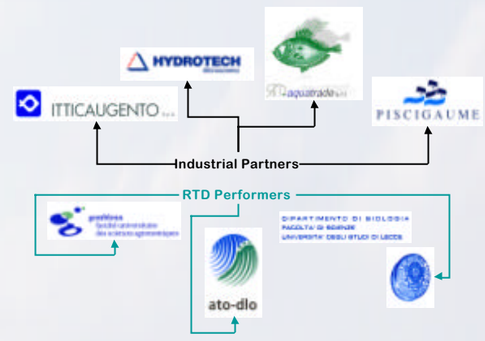


Fig. 2 The Partnership

PROJECT STRUCTURE and LOCATION

The research has been carried out at an intensive sea water fish farm farm located in the South-East of Italy (Fig. 3 A and Table 1) and has been approached through a series of steps, as summarised in Fig. 4

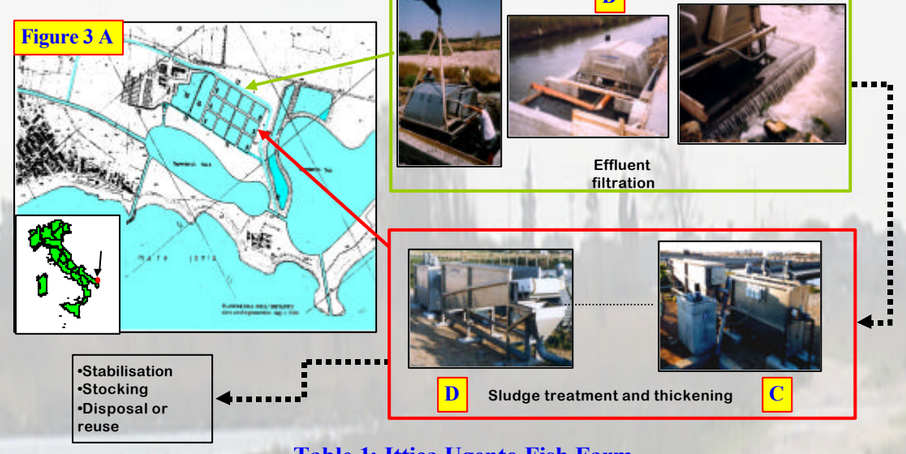


Table 1: Ittica Ugento Fish Farm

Structural Information

- REARING TANKS
  - 36 tanks of 50 sm each
  - 22 tanks of 240 sm each
  - 48 tanks of 625 sm each
- TOTAL WATER NEEDS: 2700 liter/sec
- SOURCES: IONIAN SEA, WELLS
- PERSONNEL: 25

Production

- SPECIES: SEA BREAM, SEA BASS, SHEEPHEAD BREAM
- FRY PRODUCTION (3-5 g): 4 MILLIONS
- COMMERCIAL SIZE FISH PRODUCTION: 400 TON/YEAR
- FEED CONVERSION RATE: 2:1

PROCESS DESCRIPTION

The micro-filtration system is represented by a disk-filter (Hydrotech, Sweden) equipped with 60 micron nylon nets (Fig. 3 B) . The suspended solids present in the effluent are retained in the inner part of the filter. They are subsequently removed by the operation of a backwashing system and transferred in a collecting tank. From here, the wastewater is pumped to the coagulation and flocculation tanks (Fig. 3 C) and then to a belt filter for the final thickening process (Fig. 3 D) . The coagulation is due to the action of metal ions to wastewater while the flocculation process is obtained by adding an appropriate polymer.
The main technical parameters are summarised in Table 2.

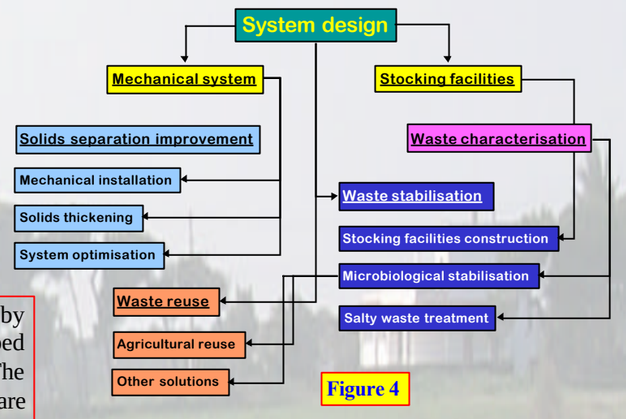


Figure 4

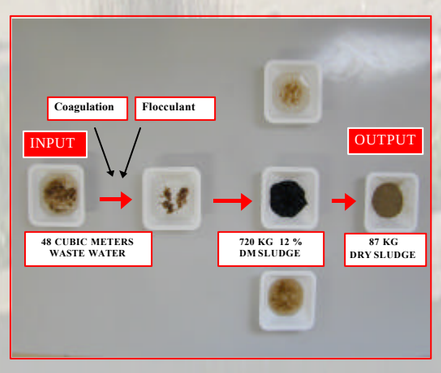
THE DISK FILTER RECEIVES WATER FROM:

• TANKS	24 of 625 sm each
• EFFLUENT	300 liter/sec
• SUSPENDED SOLIDS CONTENT	50-300 mg/liter
• ESTIMATED PRODUCTION	150 Tons

Table 2

RESULTS

System optimisation



In this figure, the products obtained in the various process steps with the relative volume involved are presented.
Once the system has been installed in the final configuration and optimised, the efficiency of the entire system ranged between 40 and 60 %.

Waste characterisation

	Waste water	Sludge	Urban Waste*
pH	7.8	7.8	6.85
Salinity (ppm)	37.5	35.33	-
Dry Matter (%)	0.5	14	-
Organic Carbon (%)	43.8	25.8	39.2
Nitrogen (%)	9.65	4	5.31
Fats (g/Kg)	29	17.24	ND
Aliphatic Hydrocarbon	1.2	0.32	ND

In these tables data from a representative experiment are presented. Similar quantitative and qualitative results were obtained using 3 different flocculants.

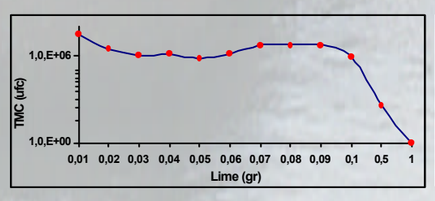
Microbiological Parameters	Waste water	Sludge
Total coliform (MPN/100 gr)	26	98
Faecal coliform (MPN/100 gr)	26	98
Faecal streptococci (MPN/100 gr)	26	26
Spores of SR Clostridia (CFU/100gr)	280	310
Salmonella sp	0	0

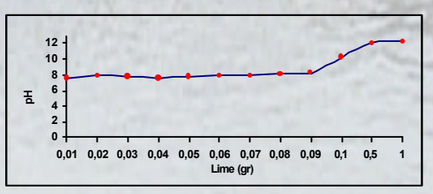
Elements (mg/Kg)	Waste-water	Sludge	Urban Waste*
Ca	31100	29438	ND
Na	36800	30074	ND
K	7830	10569	8100
Ti	219	231	ND
Al	384	2134	ND
Mg	7920	10880	ND
Fe	2860	15858	4061
Cr	10.8	26.6	ND
Zn	ND	160	415
Cu	543	82.6	151
Pb	10.1	15.5	85
Ni	4.71	9.5	22
Cd	<0.3	<DL	1
Hg	<2.0	<DL	ND
Sr	201	168	ND
Mn	58.3	71.9	70

DL Detection Level
ND Not Detected

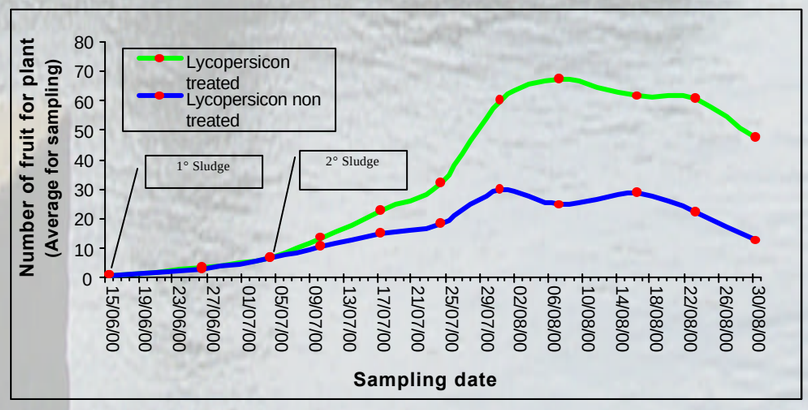
Total PCBs (ppm) $< 10^{-3}$
PAH (ppm) $< 10^{-3}$

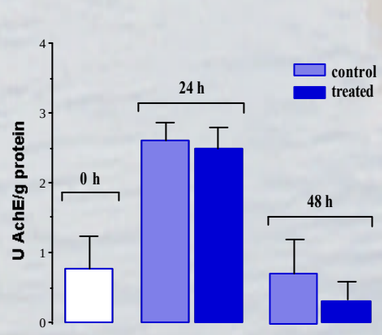
Waste Stabilisation



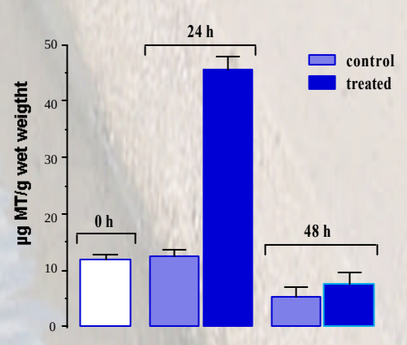


Waste Reuse





Effect of dried sludge (0,01%) on Acetylcholinesterase activity measured in *Palaemon aspersus* muscles



Effect of dried sludge (0,01%) on the metallothioneins concentration measured in *Palaemon aspersus* hepatopancreas

CONCLUSIONS

- THE SYSTEM HAS BEEN COMPLETELY CHECKED IN ITS OPERATIONAL CHARACTERISTICS AND OPTIMISED. THE SYSTEM NEEDS ONLY MINOR IMPROVEMENTS
- THE COAGULATION AND FLOCCULATION TESTS HAVE BEEN SHOWED A HIGH EFFICIENCY OF THE PROCESS.
- AMONG ALL FLOCCULANTS TESTED ONLY 3 SHOWED GOOD RESULTS IN TERMS OF EFFICIENCY, PARTICLE SIZE OBTAINED, CONSISTENCY AND SEDIMENTATION TIME
- THE DRY MATTER CONTENT IN THE CONCENTRATED SLUDGE (12-14 %) SEEMS A GOOD RESULT, BUT ANYWAY THE SYSTEM TO RECOVER THE SLUDGE FROM THE BELT FILTER CAN BE IMPROVED
- FROM CHEMICAL ANALYSIS, IT HAS BEEN CONFIRMED THAT THE EXAMINED SAMPLES ARE OF ORGANIC ORIGIN BECAUSE PREVALENTLY CONSTITUTED OF CARBON, NITROGEN, POTASSIUM, SODIUM. IN THE SLUDGE IT IS EXCLUDED THE PRESENCE OF POLLUTANTS AS HEAVY METALS, PAH AND PCBs OR FAECAL CONTAMINATION
- TESTS ON SLUDGE TREATMENT WITH LIME SUGGEST THAT THIS REAGENT CAN BE USEFULLY EMPLOYED FOR MARINE SLUDGE STABILISATION
- THE TRIALS PERFORMED ON WASTE REUSE CONFIRM THE POTENTIAL UTILISATION OF SLUDGE EITHER FOR AGRICULTURE AND/OR AQUACULTURE PURPOSES.

Aknowledgement

The authors would like to thank Roberta Schiavone, Pietro Caniglia and Rita Accogli from the Department of Biology of Lecce University for their excellent technical support. Thanks also to Dr. Licinio Corbari.
Project co-financed by EU in the framework of Craft Initiative (contract FAIR 98-9110)

REFERENCES

Bowler (Applied Geography) 1999
L.A. Kelly et al. (Aquaculture International) 1997
L. Kuai et al. (Bioresource Technology) 2000
J.A.Pascal et al. (Bioresource Technology) 1999
C.P. Waring et al. (Environmental pollution) 1996
Y. Watanabe and K. Tanaka (Wat. Res.) 1999