

FLOCCULATION BY MEANS OF ALUMINIUM HYDROXYCHLORIDE ("LOCRON L")  
 $Al_2(OH)_5Cl_2 \cdot 3H_2O$

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Traditional sand filters retain most of the dirt present in the water but very small particles pass through the sand layer and return to the pools where the animals are kept. The presence of these small organic particles causes a turbidity in the water and greatly increases the use of chlorine, by which they are partly oxydised. In order to remove these fine particles a flocculation solution is slowly introduced into the pipes through which the water is transported from pools to filters. The solution forms together with the small particles "flocks" that are bigger than the particles and, therefore, better filtered out by the sand.

As flocculating agents we have been using for years aluminium sulphate and sometimes sodium aluminate. Such products, combined with a good chlorination and a good turn-over, give very clear water. We have been satisfied by this system, for after a long experience we exactly know what to do. Nevertheless, by looking through the windows in the pool - an underwater view allows a much better visual control than looking from above to the bottom - we sometimes noticed that the clarity was not as perfect as we wanted it to be.

Accumulation of dirt in the filters causes the pressure to increase. When the maximum allowable pressure is reached, the filters must be back-washed. We experienced, however, that for keeping a cristal clear water the filters had to be back-washed long before the maximum pressure was reached. Most of the time we have had five to seven dolphins and during years we have been back-washing the filters every fortnight. We probably could have waited longer, but the clarity was better this way. In March 1981 the number of dolphins was increased to nine. Since then we have six *Tursiops* and three *Sotalia*, and we felt compelled to back-wash the filters every ten or twelf days, thirty minutes per filter.

Ten months ago we started an experiment by flocculating with another product that our colleagues of Dolfirado in Stein (the Netherlands) had recommended. This product, aluminium hydroxychloride, is commercially named "Locron L"; the L stands for liquid. It is colourless and looks oily. The dealer informed us that "Locron" had to be diluted tenfold with fresh water; if more water would be added the pH would exceed 5 and the solution would start flocculating.

Instead of dosage-pumps, with which we had bad experiences in the past, we prefer to use a tub, from which the solution regularly flows to the filters. We worked this way for many years, using a tub with a capacity of 160 liters. Complying with the instructions we took for our first "Locron" experiment a much smaller tub and started with 1.5 litre of "Locron" to which fourteen litres of water were added. From such a small quantity a regular dosage during 24

hours was not easily obtained, so, in opposition to the dealer's instructions, we soon added more and more water. We finally found that we could use the large tub again for 150 litres of water and 1.5 litre of "Locron", without causing an advanced flocculation. The large tub was definitively used again, with very satisfying results: the water remained cristal clear and less chlorine was used.

We then started reducing gradually the quantity of "Locron" to one litre. The water kept extremely clear and the quantity of chlorine remained approximately unchanged. Encouraged by these results we again gradually reduced the quantity of "Locron" to 0.5 litre, but after four weeks we found that the required quantity of chlorine had strongly increased. So we worked again with one litre of "Locron" and after three weeks we noticed that the quantity of sodium hypochloride was reduced by 20 litres a day; this was 25%.

As the water remained perfect we started to delay back-washing the filters, notwithstanding the fact that they were at least as heavily loaded as before using "Locron". At first we waited three weeks instead of twelve days, thereafter even four weeks. The clarity of the water remained unchanged, so we continued back-washing every four weeks. Although after such a period the filters are rather heavily loaded - however without reaching the maximum allowed pressure - it is not necessary to back-wash longer than 30 minutes per filter. This is the same time as we needed after twelve days when using other flocculating products and when the filters were less loaded. We conclude that with "Locron" the particles of dirt are much better retained by the sand layer than with other "flocks" and that this product is much easier to remove from the filters.

As everything seemed to work very smoothly we switched off one of the four circulation pumps, changing the turn-over time from less than two hours to 2.20 - 2.65 hours. After 3.5 weeks we have not noted any influence on the water quality.

The practical and economical advantages of "Locron" can be summarised as follows:

- 1) Less frequent and not more lengthy back-washing. This means that fresh water used for back-washing is reduced to less than 50%.
- 2) Less salt required. After each back-washing the fresh water contained in the filters mixes with the water in the pools and salt must be added in order to keep the salinity balance. The use of salt has been reduced to less than the half.
- 3) A constant and perfect clarity of the water.

"Locron" is more expensive than the traditional flocculating products, but, owing to the fact that less chlorine is needed, the expenses remain approximately equal. Moreover, working in this way, we shall save yearly approximately 25,000 Kg of salt ( $\text{NaCl}$ ) and 3,000  $\text{m}^3$  of tap-water.

We informed the dealer about the way we work with "Locron", especially about the great dilution, of which the pH is roughly 6. In the dealer's opinion such a solution would certainly start flocculating after some time. This would be an undeniable disadvantage when the solution is prepared for use during several weeks. A sample of our solution, kept in a closed glass for 8 weeks, is still as clear as clear can be. It is a fact, however, that if three drops of "Locron" are rinsed in 0.5 litre of water immediate flocculation takes place.