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Current status of shellfish purification (depuration) in England and Wales

by

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SUMMARY

Shellfish purification (depuration) continues to be widely applied in England and Wales for the treatment of shellfish taken from areas subject to faecal sewage pollution. Wider application of the chlorine treatment method in use at Conwy, North Wales is limited by lack of suitable sites and high capital cost of the large tanks necessary for treatment of mussels. The majority of live oysters marketed now pass through purification systems utilizing ultra-violet light and this has led to development of a high density unit which can also be used for purification of the hard clam (<u>Mercenaria mercenaria</u>) which requires a higher minimum water temperature. The present paper reviews current purification practice in England and Wales and includes notes on the high density system and associated developments.

INTRODUCTION

Purification of molluscan shellfish to render them free of faecal pollution has a history of almost half a century in England and Wales. Prior to the extensive work by Dodgson (1928) which used chlorine as a sterilizing agent for seawater in the purification of mussels, purification was undertaken during storage of oysters in intertidal pits before sale. Cole (1954) demonstrated that pits of this type could be used for purification particularly in areas free of pollution. The Dodgson system of mussel purification is still in use at Conwy, North Wales, where it was originally developed. Since that time the process has been adopted elsewhere with minor modifications (Reynolds 1956), and in the 1930s the method was used regularly for purification of oysters at Brightlingsea, Essex (Wood 1957). Extensive experience in England and Wales has shown that the chlorine method is cheap to operate and ideally suited to the large scale treatment of molluscs such as the mussel (<u>Mytilus edulis</u>), a relatively cheap commodity compared with the oyster. The method has not been more widely adopted even for mussels, primarily because of the lack of suitable sites and the high capital cost of constructing the large tanks necessary to purify mussels on a commercial scale.

In looking for a smaller scale method to be applied to the purification of the European Flat Oyster (Ostrea edulis), a more valuable commodity, Wood (1961) investigated the use of ultra-violet light. Following on from this initial development, tank systems of various types, all using ultra-violet light, have been constructed in England and Wales. At the time of writing about 24 of these systems are in commercial operation and have permitted utilization of oyster stocks from areas known to be polluted by sewage, including many which are closed or restricted under the Public Health (Shellfish) Regulations, 1934. An interesting result of the widespread use of purification has been to confer a special status on purified oysters which is now used as a selling point by wholesalers. In consequence, it is current practice to subject to a purification process the majority of marketable oysters in England and Wales regardless of whether they come from polluted areas or not.

FURTHER DEVELOPMENT

All of the u/v systems operate on the same basic principle of holding oysters in recirculated seawater for a period of 36 h during which time the water is subjected to a period of ultra-violet irradiation. The background to the need for purification and other forms of treatment together with a review of the methods used has been published elsewhere (Wood 1961, 1969). Continued use of these systems and contact with commercial operators revealed a need for a small unit (capable of subsequent expansion) occupying limited floor area and suitable for processing high densities of shellfish in relatively small volumes of water.

The temperature requirements of European flat oysters (Ostrea edulis) and the Crassostrea species (gigas and angulata) are such that purification may be achieved at water temperatures not below 5°C, and little supplementary water heating is therefore required during winter months. Commercial exploitation of the hard clam (Mercenaria mercenaria) stocks in Southampton Water for the export market and limited home consumption led to an assessment of the purification requirements of this species. Although more tolerant of low salinities than the oyster species, it was evident that the hard clam virtually ceased feeding below 10°C and to all intents and purposes hibernated during the winter months. Existing commercial purification plants for oysters and mussels were known to be generally effective for these species in winter but to adopt them for winter operation at water temperatures approaching 15°C, such as are required by Mercenaria, was prohibitive in terms of cost. To overcome this it was decided to look at the treatment of high densities of shellfish in relatively low volumes of water. Additionally there has been an increasing demand for purification and live storage facilities at inland sites, i.e. at market level. Here, use is made of artificial seawater which can be conveniently prepared from tap water by the addition of five simple salts (see Wood 1966) but the costs of the preparation of water volumes of the size required by conventional u/v systems are prohibitive.

In summary therefore, there was an obvious requirement for a purification system incorporating the following parameters:-

1) Small water volume without reducing shellfish density below that of a comparable conventional system; this makes it economic to heat water and use artificial seawater.
2) Compact for use in restaurants etc where floor area is limited.
3) Multi-purpose purification and storage (including storage of crustacea).
4) Demountable (if required) and convenient for handling of shellfish.
5) Capacity easily extended when required.

THE HIGH DENSITY UNIT

Fulfilment of these parameters has been successfully achieved by the development of the system illustrated in Figure 1, and a commercial scale unit constructed in the laboratory on this principle has been evaluated. The unit consists of a slotted angle framework holding 10 moulded fibreglass trays supported on runners one above another. Each tray is fitted with plastic standpipe overflows which permit filling to a depth of 3 inches (76 cm) before water overflows into the tray below and so on down through each tray into a sump or collecting tank. Each tray is also fitted with two plugged drainholes to facilitate emptying the unit when purification is complete. Water from the sump is pumped through a titanium sheathed immersion heater and an enclosed ultra-violet light unit for sterilization before being delivered to the top tray of the unit. In view of the relatively high cost of commercially produced u/v sources operating on a flow through principle, a simple do-it-yourself u/v sterilizer has been adopted to reduce cost of this item by almost 90%. This sterilizer uses a 30 watt TUV germicidal lamp mounted inside a plastic water jacket. Although this unit is approximately 20% less efficient than a similar commercial unit in terms of the instantaneous kill of bacteria present in seawater, the relatively low water volume and high rate of recirculation gives an accumulative kill of 99.9% of waterborne Escherichia coli in <2h when evaluated with sewage polluted water; for comparison the accumulative kill in a conventional u/v shellfish purification system is about 6h.

Direct immersion of the u/v source in water results in some loss of efficiency due to the cooling effect of the circulating water. To overcome this, further work is now in progress to develop a unit where the u/v source is contained within a quartz tube to provide an air jacket between the source and the circulating water.

A number of commercial operators tend to regard purification units as a convenient method of live storage of both molluscs and crustaceans, which in high density systems may be undesirable because of the accumulation in the water of waste products from the shellfish. Simple biological filters using cockle shell (Cardium edule) as the medium have proved successful for lobster storage units of a similar design. The value of these filters to molluscan purification systems is now being evaluated.

REFERENCES

COLE, H.A., 1954. Purification of oysters in simple pits. Fishery Invest., Lond., Ser II, 18, No. 5, 12pp.

DODGSON, R.W., 1928. Report on mussel purification. Fishery Invest., Lond., Ser II, 10, No. 1, 498pp.

REYNOLDS, N., 1956. A simplified system of mussel purification. Fishery Invest., Lond., Ser II, No. 8, 18pp.

WOOD, P.C., 1957. The cleansing of oysters. Recent changes in the methods used at Brightlingsea. Publ. Hlth., Lond, 70, 92.

WOOD, P.C., 1961. The principles of water sterilization by ultra violet light and their application in the purification of oysters. Fishery Invest., Lond., Ser II, 23, No. 6, 48pp.

WOOD, P.C., 1966. Lobster storage and Shellfish Purification. Lab Leaflet. Fish Lab., Burnham-on-Crouch, (NS) No. 13.

WOOD, P.C., 1969. The production of Clean Shellfish. Lab. Leafl., Fish. Lab., Burnham-on-Crouch (NS), No. 20.

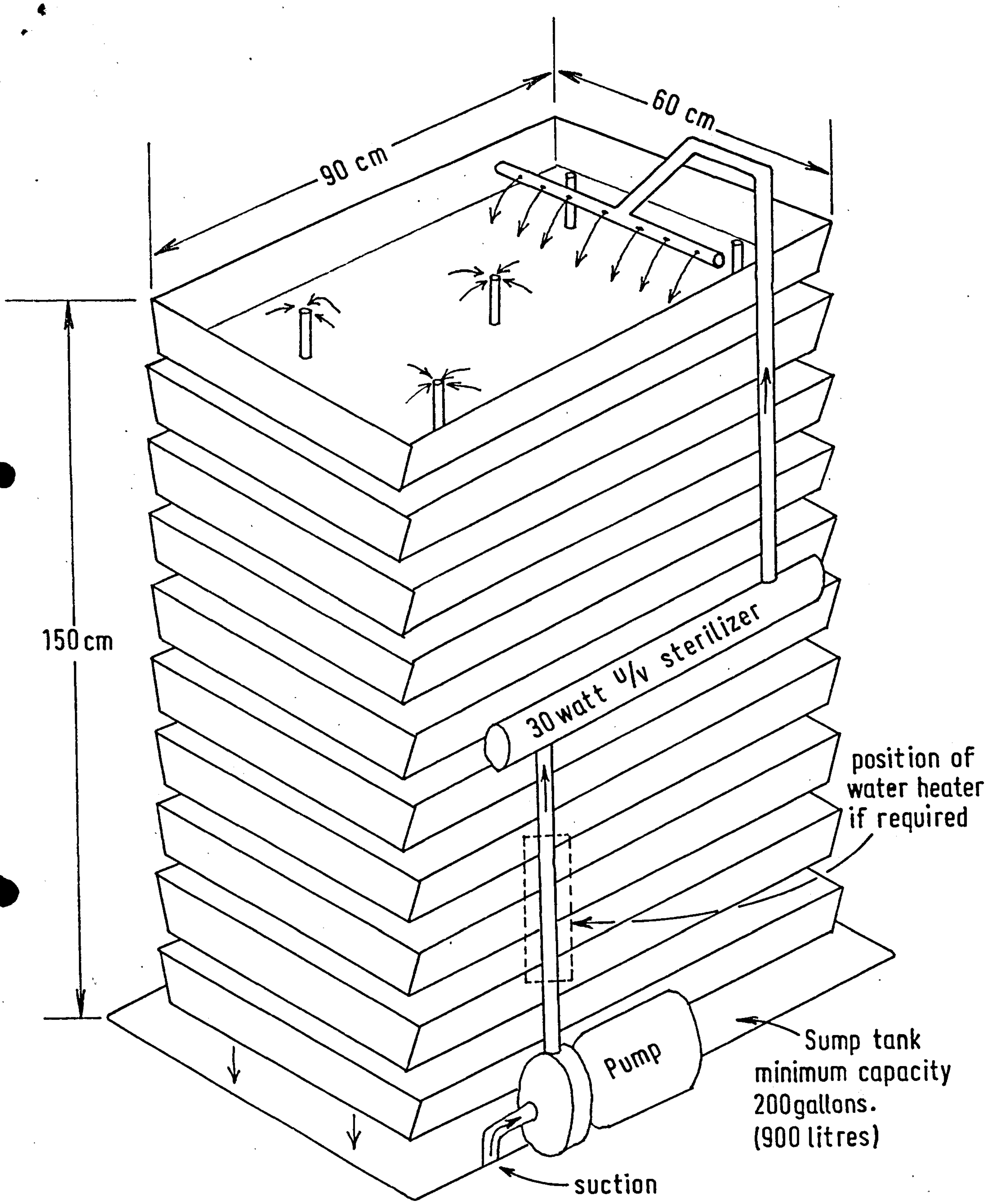

Fig 1. Diagram of general layout of high density purification system (details of framework omitted)