

Sea Fish Industry Authority

Seafish Technology

Field Trials of a Prototype Indirect Ice Chilled Display Cabinet

Internal Report No.1426

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Summary

From the 1st of April 1993, the Food Hygiene (Amendment) Regulations will demand that all pre-cooked and ready-to-eat smoked fish products are stored and displayed at no more than 5°C.

The Department of Health is currently reviewing this requirement. It is likely that these products will be allowed to be kept at up to 12°C for 16 hours or up to 8°C for 48 hours, as a total period from preparation to sale. After this period products must be removed from sale and discarded. Products held at or below 5°C would not have these restrictions.

A recent Seafish survey showed most existing equipment is not capable of meeting the new temperature requirements. As a result of previous work (Seafish Report No. 1424), Seafish Technology is currently developing inexpensive storage/display cabinets which use ice to indirectly chill products below 5°C.

This report is concerned with the field trials of a prototype cabinet carried in a mobile van during the summer of 1992. The aim of the work was to monitor the temperature of products sold from the cabinet and traditional shelf display. The trials were used to gain practical experience which could then improve the design of future cabinets.

Three main conclusions can be drawn from this work:-

- 1) The unit combined with good practice can successfully keep products below 5°C and hence satisfy the requirements of Food Hygiene Regulations.
- 2) Products on traditional open shelf display warmed up rapidly to just below outside ambient temperature. Displays of this type are not considered to be good practice, as product temperatures quickly rise above an acceptable level especially during the summer months.
- 3) The temperature of the storage area from which the cabinet is stocked is of vital importance, especially during periods of high turnover.

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1. Introduction

From the 1st of April 1993, the Food Hygiene (Amendment) Regulations will demand that all pre-cooked and ready-to-eat smoked fish products are stored and displayed at no more than 5°C.

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This report is concerned with the field trials of a prototype cabinet carried in a mobile van during the summer of 1992. The aim of the work was to monitor the temperature of products sold from the cabinet and traditional shelf display. The trials were used to gain practical experience which could then improve the design of future cabinets.

Cooked and smoked products which require temperature control can be split into two groups, fillet and non-fillet type products. In this series of trials the temperature of split kippers were monitored to represent typical "fillet" type products whilst cooked/peeled prawns were monitored to show results typical of "loose" products, such as cockles, mussels and crabsticks etc. As kippers and prawns were the best selling products the affect of sales and restocking on temperature was also observed.

Four trials were carried out in a semi insulated Ford Transit van by kind permission of Mr Gordon Green (Ocean Pride Fisheries), Hon. Secretary of the Grimsby Mobile Fish Retailer's Association.

The aim of Trial 1 was to monitor the temperature of kippers and prawns sold from the cabinet over a six hour period of door-to-door sales.

The aim of Trial 2 was to monitor the temperature of kippers and prawns sold from a traditional open-shelf display. This trial would allow a comparison to be made between temperatures of products in the prototype and on traditional display.

Trial 3 was carried out to determine if inclining the cabinet to improve display would have a significant effect on product temperature.

Trial 4 was carried out to determine the effect of operation on a fixed market type pitch (van doors open most of the time) on products sold from the cabinet.

2. Construction of the prototype Cabinet

The cabinet was designed to hold four 300mm x 240mm x 60mm deep stainless steel trays laid out horizontally side by side embedded in ice. The cabinet was constructed by sandwiching 30mm thick slabs of polystyrene between two thin layers of fibreglass to form an insulated trough of inside dimensions 1180mm x 440mm x 160mm deep.

A split lid and central partition were made from 5mm clear acrylic sheet. The partition was bonded in position with silicone sealant; lids were hinged and handles fitted. Drain holes of 20mm diameter were made in the floor of each compartment and 6mm access holes were made in each end wall of the unit to allow entry of thermocouple cables, these were blanked off with rubber grommets when not in use.

A sketch of the cabinet is shown in *figure 1* below.

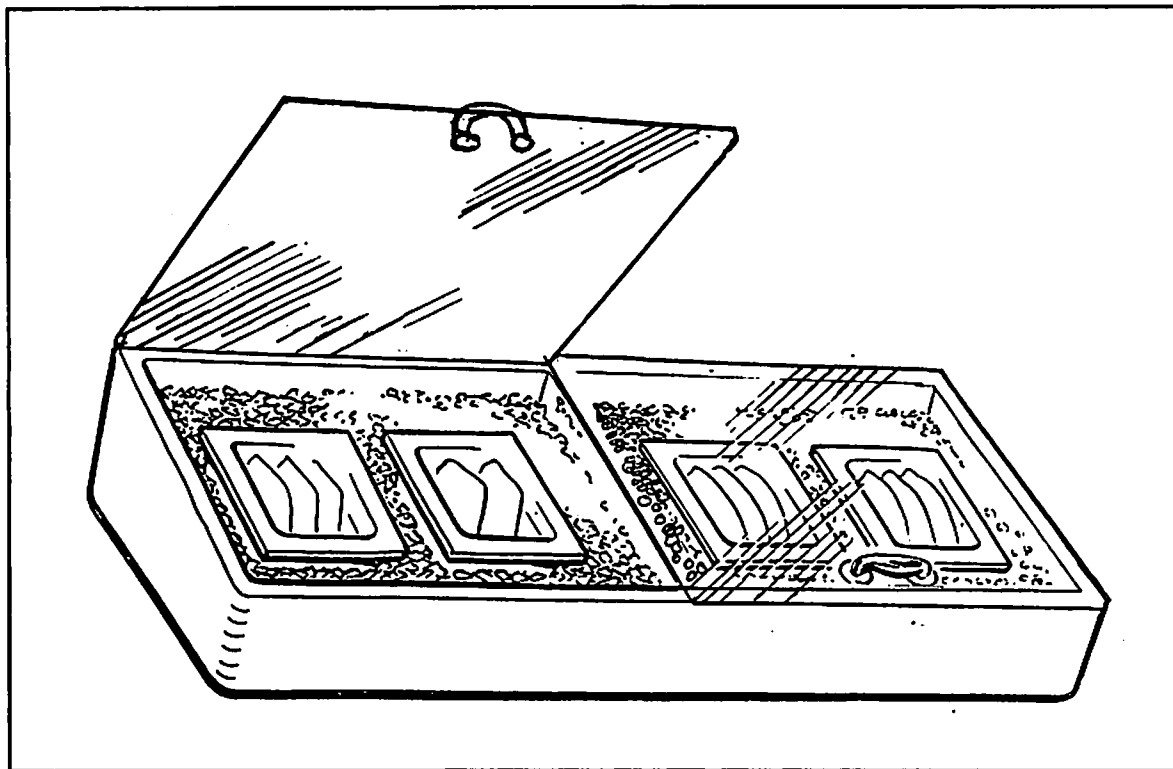


Figure 1 - Diagram of the prototype cabinet

3. Common Experimental Method

The trials were carried out during August and September 1992, with the van working in the Byfleet (Surrey) area, selling fish from Grimsby.

The stainless steel trays were embedded in ice in the cabinet to give a 60mm air gap between ice and lid.

Kipper fillets and prawns stored at 0°C were placed in separate trays up to the level of the ice surface. Type T thermocouples connected to a Squirrel™ Data Logger were inserted into the top fillet or top 15mm layer of the product. A thermocouple was also inserted in the air gap between the product and cover.

When the cabinet was opened for a sale or product re-stocking the time was noted and the thermocouple replaced in the new top kipper fillet or top layer of prawns.

In all the trials air temperature in the sales area was recorded in the centre of the van 600mm below the roof.

Product temperatures were recorded every 10 minutes over a 6 hour sales period. Ambient air temperature was recorded at frequent intervals using a hand held digital thermometer.

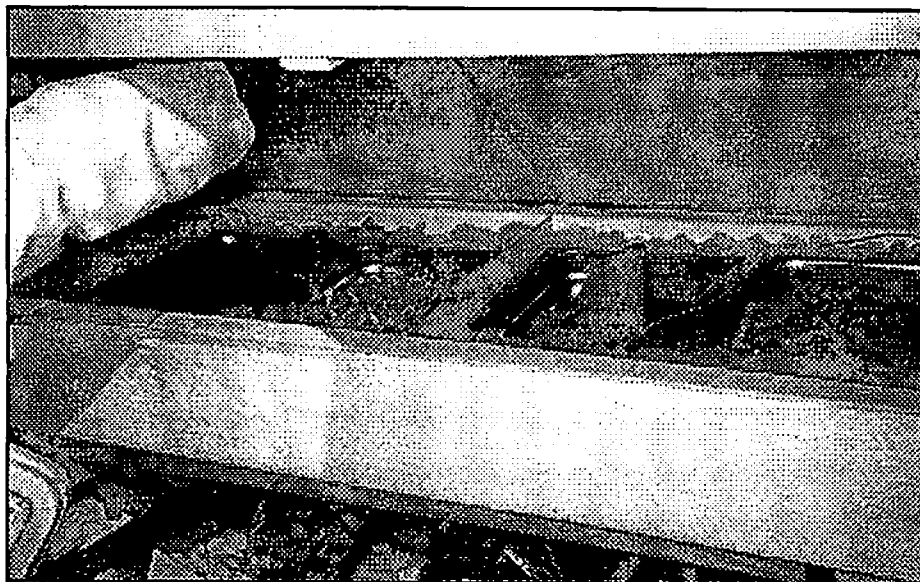


Figure 2 - The prototype cabinet containing products

3.1 The Van Sales Pattern

The van sales pattern was of two types. The first type carried out in trials 1-3 consisted of calling at regular customers, on a fixed route. Van doors were opened for periods of between 3 and 15 minutes during each sale. After the sale the van doors would be closed for approximately 1-5 minutes during the drive to the next customer.

The second type of sales was the fixed "market" type pitch where the van parked at a fixed spot all day with the van doors open throughout most of the trading period.

4. Trial 1 - A trial to monitor the Temperature of Kippers and Prawns in the prototype Cabinet

4.1 Introduction

The aim of this trial was to monitor the temperature of kippers and prawns sold from the prototype cabinet over a 6 hour period of door-to-door sales.

4.2 Method

The trial was carried out according to the method detailed in Section 3.

4.3 Results

Results of the trial are shown in *figure 3*. Average ambient air temperature was 19.2°C.

The average air temperature inside the van sales area was 16.1°C compared to 4.83°C recorded in the cabinet between the products and the lid.

Kippers placed in the unit at 3°C remained at 3°C ± 1°C for 6 hours.

Peeled prawns placed in the unit at 0°C remained below 2°C.

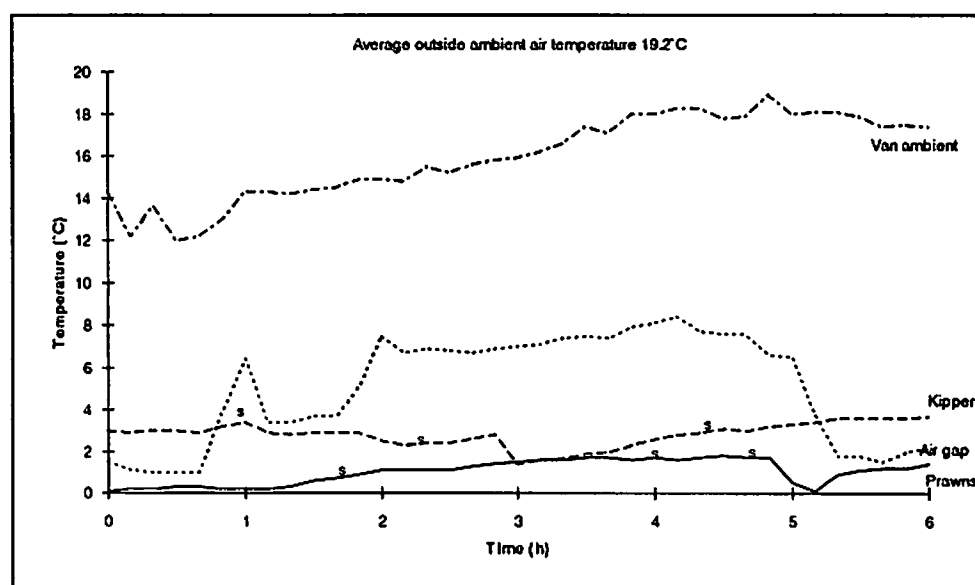


Figure 3 - Van ambient and product temperatures recorded in the cabinet
S Point of Sale, R Re-stocking

The unit was opened six times for sales, no products were re-stocked.
Condensation was apparent on the outside of the lid, affecting the display.

The rate of ice melt was insignificant during the trial and re-icing was not required.

5. Trial 2 -A trial to Monitor The Temperature of Kippers and Prawns on Traditional Shelf Display.

5.1 Introduction

The aim of this trial was to monitor the temperature of kippers and prawns sold from a traditional shelf type display over a 6 hour period of door-to-door sales.

5.2 Method

Temperature monitoring was carried out according to the method detailed in Section 3. Products at 0°C were placed in separate stainless steel trays on an inclined shelf 600mm below the van roof (*figure 4*).

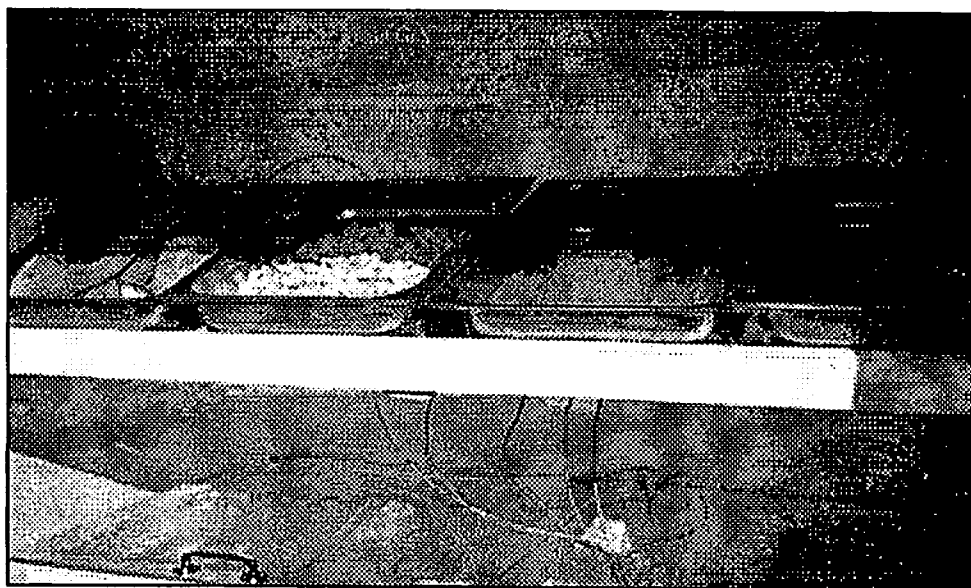


Figure 4 - Products on traditional shelf display

5.3 Results

The results of the trial are shown in *figure 5*. Average ambient air temperature was 21°C. The average air temperature in the van sales area was 17°C.

Both kipper and prawns warmed up rapidly at approximately 6°C per hour over the first 2 hours on display. When the temperature of the products approached ambient van temperature, the rate of warming slowed.

Kipper fillets had warmed up to 14°C after 6 hours whilst prawns reached over 19°C. Five sales were recorded. The tray containing kipper fillets was re-stocked with fillets from the storage area after three hours (indicated by the sharp fall in temperature at that point).

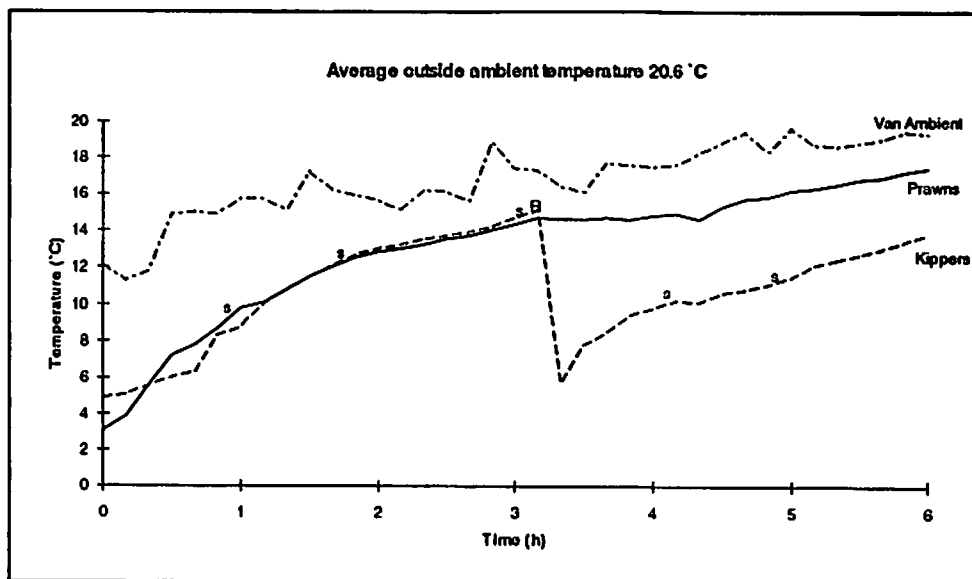


Figure 5 - Van ambient and product temperatures recorded on a traditional shelf display. S Point of Sale, R Re-stocking

6. Trial 3 A trial to Monitor the Temperature of Kipper Fillets and Prawns in the Prototype Cabinet Inclined at 20°

6.1 Introduction

The aim of the trial was to monitor the temperature of kippers and prawns sold from the prototype cabinet over a 6 hour period consisting of a short "market stall" pitch and door-to-door sales.

The cabinet was inclined towards the customers at an angle of 20°. This greatly improved the display, allowing products in the trays to be seen more easily than with the unit in it's usual horizontal position.

6.2 Method

The trial was carried out according to the method detailed in Section 3.

6.3 Results

The results of the trial are shown in figure 6. Average ambient air temperature was 23°C.

The average air temperature inside the van sales area was 19°C compared to 8°C recorded in the cabinet between the products and the lid.

Kippers placed in the unit at 5°C cooled down slowly during the trial to nearly 3°C.

Peeled prawns placed in the unit at 2°C remained at 1°C \pm 0.5°C until all the prawns were sold and the tray was re-stocked with prawns at over 15°C. The graph shows prawns rapidly cooling back down towards 5°C.

The unit was opened ten times for sales and once for re-stocking.

Condensation was apparent on the outside of the lid. Re-icing of the trays was not required.

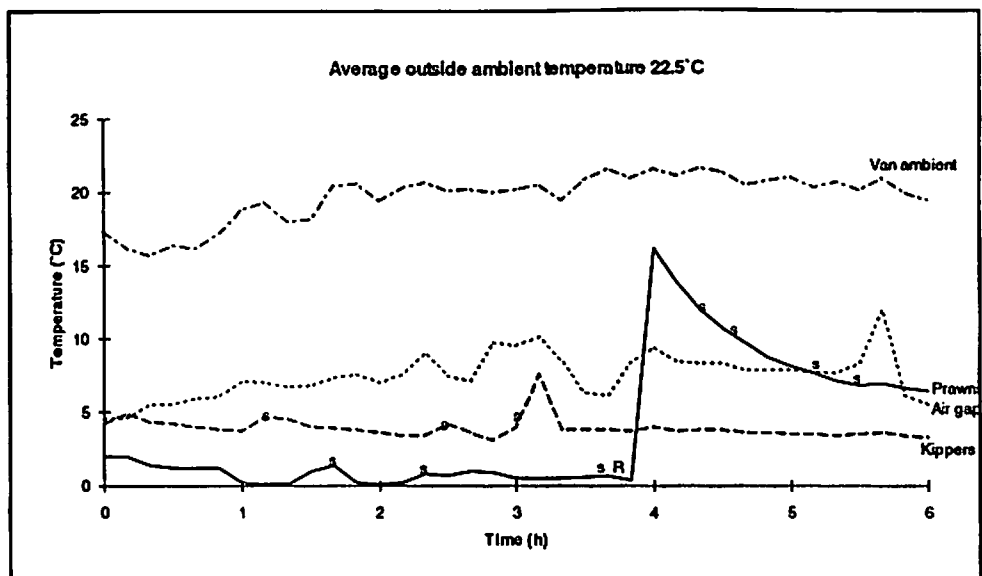


Figure 6 - Van ambient and product temperatures recorded with the unit inclined at 20°C.
S Point of Sale R Re-stocking

7. Trial 4 A Trial to Monitor the Temperature of Kippers and Prawns in the Prototype Cabinet Inclined at 20° used in a Static 'Market' Type Location

7.1 Introduction

The aim of this trial was to monitor the temperature of kippers and prawns sold from the prototype cabinet over a six hour period with the van selling from a static "market" style pitch. The cabinet was inclined at 20° to aid presentation of the products.

7.2 Method

The trial was carried out according to the method outlined in Section 3.

7.3 Results

The results of the trial are shown in *figure 7*. Average ambient temperature was 20°C.

The average air temperature inside the van sales area was 16°C compared to 5°C in the cabinet between the products and the lid.

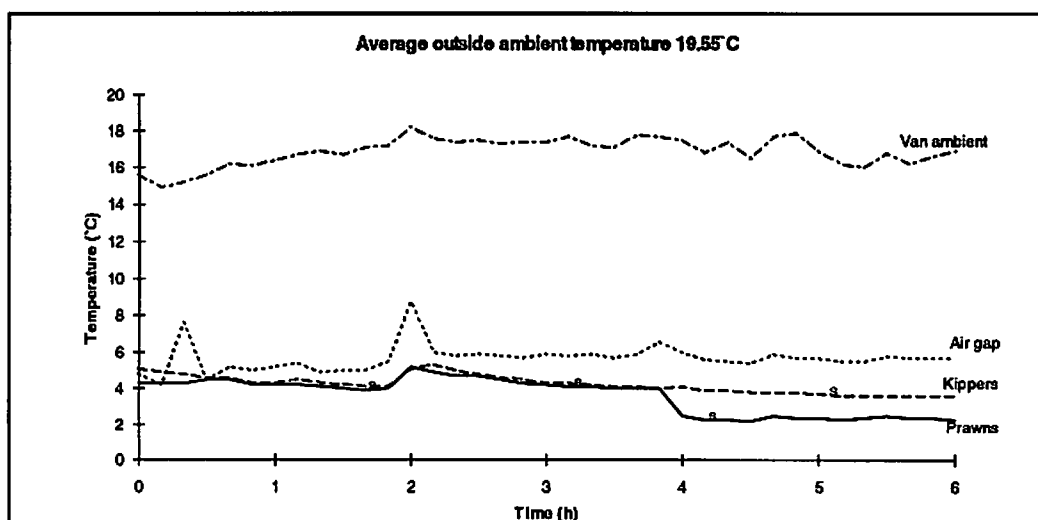


Figure 7 - Van ambient and product temperatures recorded with the cabinet used in a static "market" type location.
S Point of Sale

Kippers placed in the unit at 5°C cooled slowly to 4°C during the trial.

Peeled prawns placed in the unit at 5°C cooled to 2°C by the end of the trial.

The unit was opened four times for sales, no re-stocking was carried out. Condensation was apparent on the outside of the lid. Re-icing of the trays was not required.

8. Discussion and Conclusions

Each trial showed the prototype cabinet capable of holding products below 5°C. The graphs suggest that products could be maintained below 5°C indefinitely given re-icing and good practice.

Products on traditional shelf display warmed up rapidly to just under ambient temperature (approximately 6°C per hour). Displays of this type are not considered good practice as the product temperatures quickly rise above an acceptable level especially during the summer months.

Inclining the cabinet to improve display had no significant effect on product temperatures.

There appeared to be no difference in the effect of door-to-door sales and a fixed market type pitch on the temperature of products stored in a cabinet.

One of the most critical links in the temperature control chain is the temperature of products held in the storage area which are used for re-stocking the display. The effect of two extreme temperatures were shown in *figures 5 and 6*. In *figure 5* kippers on shelf display at 14°C were re-stocked with products at 6°C. In *figure 6* prawns in the prototype at 0.5°C were replaced with new stock at 15°C. Although, the prototype rapidly cooled the prawns back towards 5°C the above experiments show how storage practice can affect the products.

The storage area should be suitably insulated and products chilled by refrigeration or indirect contact with ice. Products already on display in the prototype cabinet could be kept overnight in the unit.

The cabinet should be topped up with ice at the beginning of each day although ice was observed to last up to four days.

One drawback with the unit was condensation forming on the perspex lid, however, subsequent laboratory trials with double glazed lids should overcome this problem and also improve chilling.

9. Future Work and Modification

These trials have shown that a cabinet of this type can keep products below 5°C. A commercial version should incorporate all the features of the prototype to ensure low product temperatures. Its design would be governed by the requirements of the operator and fitted to maximise the amount of space available in the van.

Mobile mongers may sell over ten different products which require temperature control. Efficient utilisation of available space in a van is vital. It is thought that the depth of the prototype unit could make shelf mounting of separate units impractical in a small van. To overcome this problem work is being carried out to develop an upright insulated display cabinet with doors at the front and containing several shelves on which trays in ice are situated.

Should there prove to be further requirement to improve the performance of the designs the air within the cabinets could be chilled by passing through an ice chilled heat exchanger developed by Seafish.