Fish box trials

Seafish has carried out trials to investigate the thermal properties of four types of non-reusable fish boxes for comparison (six kg or one stone capacity).

These trials were carried out because it is important to keep fish as close to the temperature of melting ice as possible in order to maintain freshness quality. Fish boxes can help with temperature control as they help retain product integrity and offer some protection against changes in the ambient temperature.

Over time, fish box designs and materials have changed and new products have been developed. The distribution chain has also seen changes, including the use of gel-ice packs and improved temperature control.

This document summarises the results of those packaging trials, providing an overview of how the fish boxes perform under different conditions. This can help seafood businesses make informed choices about the type of packaging used.

Method

Four different types of fish box were tested in an environmental chamber, which was operated at two different time-temperature profiles, using two different methods of icing.

Fish box	Supplier	Icing methods
Expanded polystyrene (EPS)	Styropack	Flake ice Ice pack
Single walled fibreboard (SWF)	CRT Packaging	
Double walled fibreboard (DWF)	CRT Packaging	
Corrugated plastic (CP)	Tri-Pack	

The time-temperature profiles

Type of distribution chain	Duration	Ambient temperature	Fillet temperature when packed
Interrupted eg airfreight.	66 hours	Variable - average of 2.8°C	4°C
Refrigerated/ controlled	72 hours	Constant 2°C	0°C

Each box was filled with 6kg of medium sized haddock fillets. Thermocouples recorded the fillet temperatures and ambient air temperature. An absorbent pad was placed in the bottom of each box to soak up any meltwater. To replicate common practice, either one gel-ice pack or 2kg of flake ice was placed directly on top of the fish and the boxes sealed. The absorbent pads and ice packs were supplied by Styropack.

Results

The average fillet temperatures for each time temperature profile and cooling method are shown separately in Figures 1 to 4.

Results of the trials with a variable ambient temperature for 66 hours

- All the fish boxes were affected to various degrees by changes in the ambient temperature, but the EPS box proved to have the best insulative properties.
- The next most effective type of box was CP, followed by DWF and then SWF. However, when using an ice pack, there is little difference in thermal performance between CP, DWF and SWF boxes, despite the CP box being more effective over the first 20 hours.

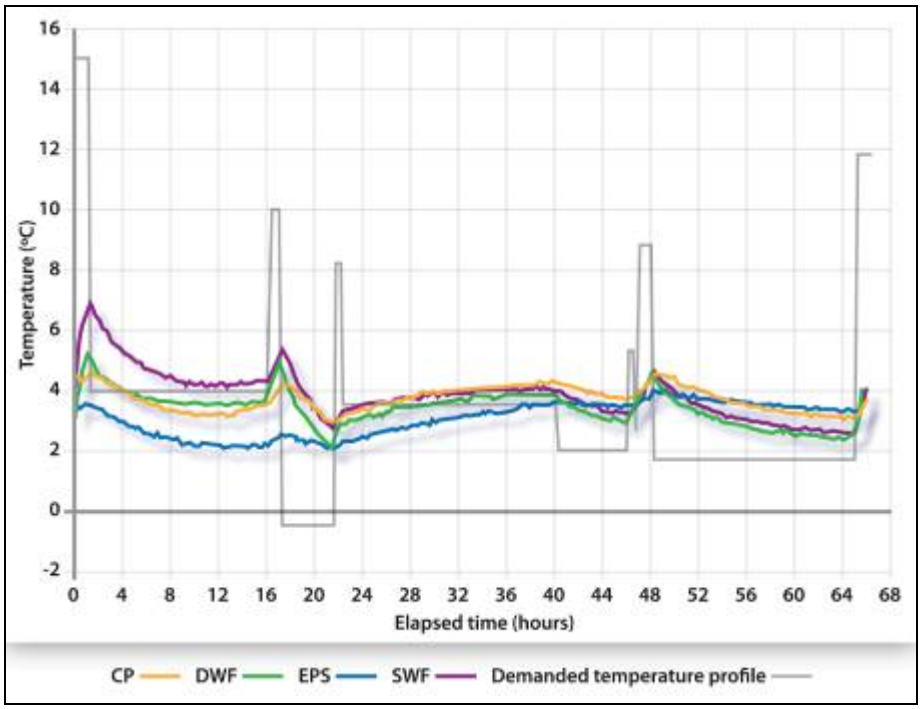

Figure 1 Comparison of fillet temperatures in boxes held in a variable ambient temperature for 66 hours (ice pack cooling)

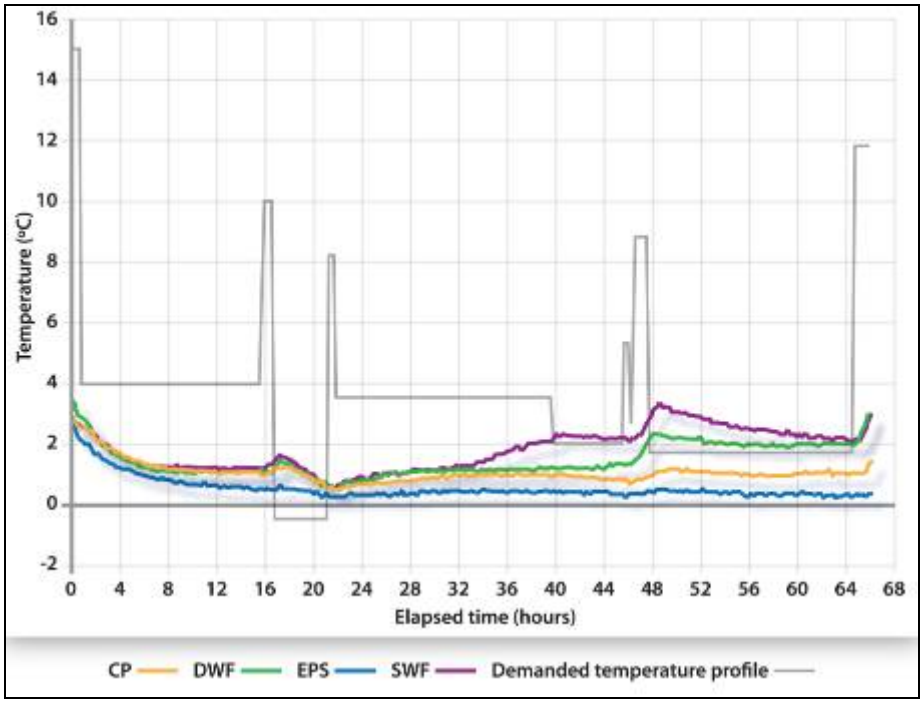

Figure 2 Comparison of fillet temperatures in boxes held in a variable ambient temperature for 66 hours (flake-ice cooling).

Results of the trials with a constant ambient temperature of 2°C for 72 hours

- The EPS box was most effective at maintaining a low average fillet temperature for both cooling methods, followed by CP, DWF and SWF boxes, respectively.
- All boxes performed satisfactorily in holding fish temperature close to 0°C, particularly when using ice. It may be beneficial to have less insulation in some circumstances to allow the chill temperatures to influence product temperatures.

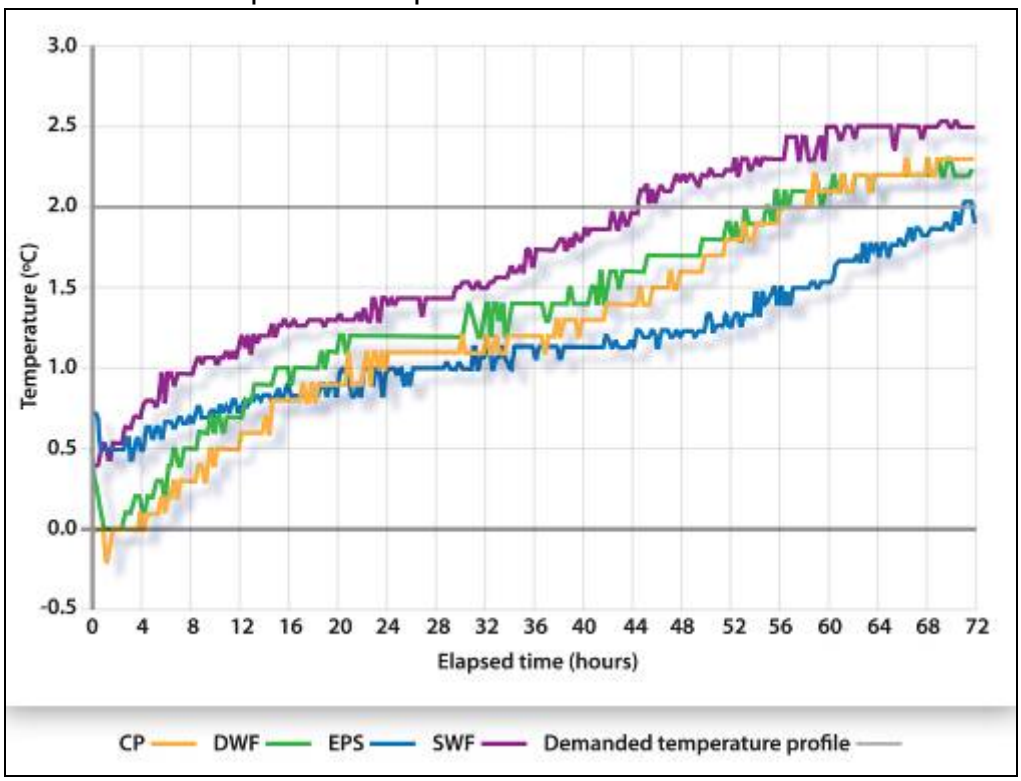

Figure 3 Comparison of fillet temperatures in boxes held in a fixed ambient temperature (2°C) for 72 hours (ice pack cooling).

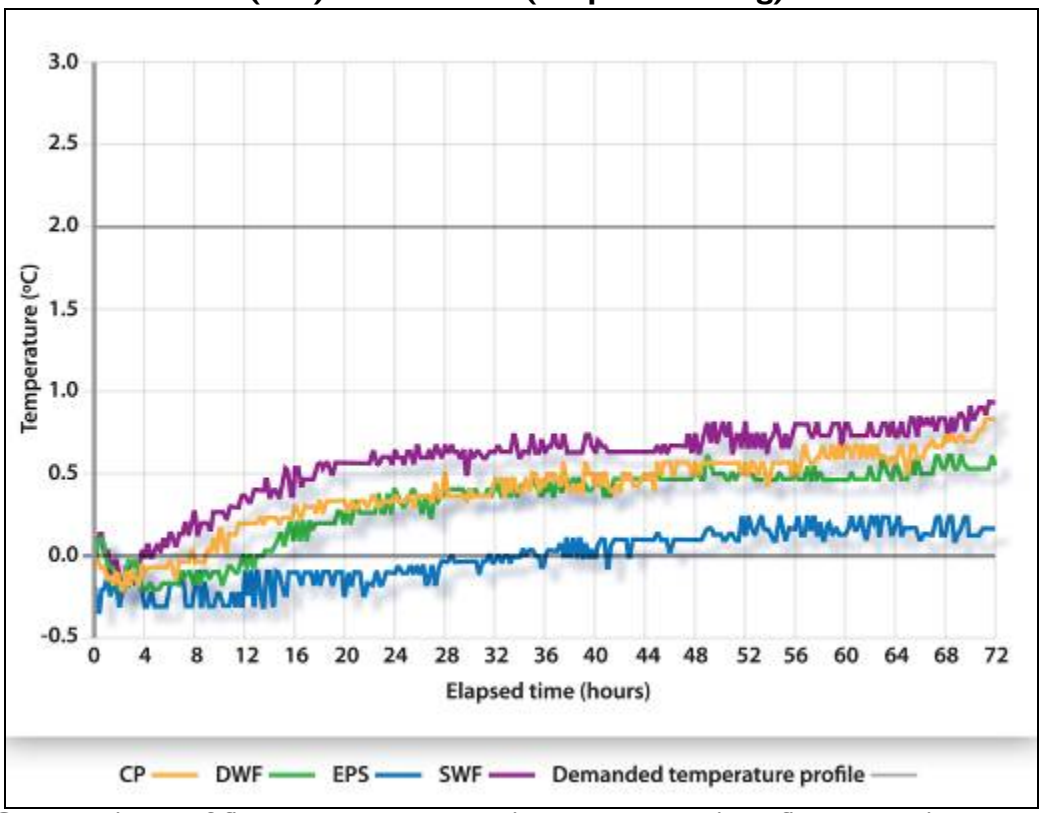

Figure 4 Comparison of fillet temperatures in boxes held in a fixed ambient temperature (2°C) for 72 hours (flake-ice cooling).

Overall observations from the trials

- The EPS box was most effective at maintaining a low average fillet temperature for both cooling methods, followed by CP, DWF and SWF boxes, respectively. However, all boxes provided adequate performance, particularly when using ice.
- In both temperature profiles, ice chilling of fillets was more effective at maintaining low temperatures than using a single ice pack.
- The practice of lining the boxes was not suitable for ice chilling, as meltwater collected in the bag and was observed to be in contact with fillets at the bottom of the fish boxes. Hygiene requirements stipulate that meltwater should be kept away from fish products. If a liner is to be used, an absorbent pad with sufficient capacity to absorb all the meltwater must be used.
- At the end of the trials using ice, the amount of meltwater produced exceeded the capacity of the absorbent pad used. The ratio of ice used and/or absorbent pad capacity needs careful consideration to prevent fillets from soaking in meltwater in non-draining boxes.
- The use of one ice pack is insufficient to keep product temperatures as low as possible, particularly in a variable ambient temperature.
- A temperature gradient was observed between fillets at the top, middle and bottom of each box for both cooling mediums. Fillets at the top of each box remained the coolest. However, by the end of each trial, temperatures had generally equalised.
- As a general observation, when using 6kg fish and 2kg of ice (typical industry practice) all boxes appeared to be overfilled. This may lead to crushing or damage to fish when these boxes are stacked and should be avoided.

Other factors to consider when purchasing fish boxes

Product integrity and temperature control should be the most important factors when purchasing fish boxes purchased. Other factors to consider include:

- material disposal - can it be easily recycled, can it be compacted etc;
- cost;
- strength;
- sufficient head space to fit ice or ice packs with the seafood;
- weight – minimising weight helps with transport and disposal;
- tamper resistance;
- ease of overprinting/marketing;
- storage – whether flat pack for easy storage.

Recommendations

- Where fish is distributed in an uncontrolled chilled distribution chain, the use of boxes with greater insulative properties, such as EPS, is advisable in order to maintain low product temperatures. Greater care to control the ambient temperatures should be taken during warmer months, particularly if using boxes with lower insulative protection.
- Where fish is distributed in a strictly controlled distribution chain, it may be beneficial to use boxes with less insulation, to allow chill temperatures to influence product temperatures.
- In general, when using ice as a coolant, it should be added on the top and bottom of the fish box, in order to rapidly cool all fillets. In non-draining boxes, sufficient absorbent pads should be used to prevent meltwater contacting the product.
- When using gel-ice as a coolant, particularly when exposed to high ambient temperatures, the fish should be pre-chilled and more than one ice pack used to effectively cool the fillets. The appropriate number of ice packs (by type) needs further investigation.

Further information:

	Expanded polystyrene	Corrugated plastic	Double or single walled fibreboard Single walled fibreboard
Suppliers used in the trial	http://www.styropack.co.uk/mos	http://www.tri-pack.co.uk	http://www.crt-packaging.co.uk
Industry organisations	http://www.eps.co.uk	http://www.bpf.co.uk	http://www.paper.org.uk
Packaging research organisations	PIRA Consultancy - http://www.pira.co.uk List of European and UK organisations http://www.iapriweb.org/members.html		
Legal requirements including contact with food	Food Standards Agency http://www.food.gov.uk/foodlabelling		
Recycling rules	Net-Regs http://www.netregs.gov.uk/netregs/275207/275453/?version=1&lang=_e		
Seafish publications	Go to http://www.seafish.org/resources/publications.asp and type 'packaging' or 'polystyrene' in the search facility		
Seafish	**Michaela Archer** **Research and Development Department** **Tel: 01482 327837 Email: m_archer@seafish.co.uk**		