Factsheet

The Role of Polyurethane in the Cold Food Chain

INTRODUCTION

This factsheet describes the important and growing role of polyurethane in the cold food chain. The main application is of rigid insulating foam in the energy-efficient transportation and preservation of food. Polyurethane is used throughout the world in these roles and plays an important part in the European Union's food chain.

SUSTAINABLE DEVELOPMENT FACTORS

Feed the World

The information below describes the challenges in feeding a world with a growing population, coupled with increasing urbanisation. The preservation of food produced from agricultural sources so that it reaches the table in a state which is fit for consumption is more and more important. Today, only about 50% of the food produced in developing countries is actually eaten. The most common, economic and efficient way of preserving food is to cool or freeze it when fresh and to keep it at low temperature during the storage and distribution phases. However, cooling requires energy in the form of electricity which is mostly generated by the use of fossil fuels.

Energy produced by the combustion of fossil fuels leads to the emission of CO_2 which is the main cause of climate change. Climate change is generally recognised as the largest environmental problem facing the world today. Amongst its many consequences will be a change in weather patterns including a reduction in precipitation in some major food producing regions, such as the American Mid-West, which will reduce the overall production of food.

Many developed countries are developing non-fossil energy sources but it will be many decades before there is enough energy from such sources. Whatever the source of energy the installation and use of energy efficient systems is critically important and this is where high performance insulation materials, such as polyurethane rigid foam, play a key role.

Population Changes

The global population (reference 1) grew from 1.6 billion to 6.1 billion in the 20th Century and is predicted to increase by a further one billion by 2015 and will reach 8.8 billion by 2050. Most of this growth will be in developing countries. The growth in the EU is expected to be less than one percent. Overall, the demand for food will be 44% higher in 2050 than it is today.

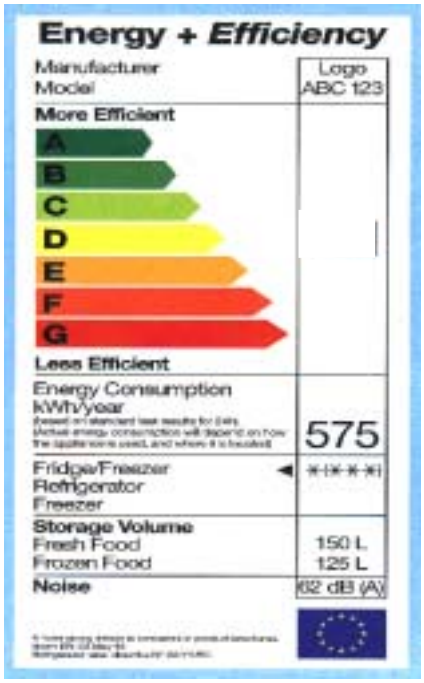
The trend to urbanisation and the expansion of already large cities has a significant impact on the food chain. Urban communities are much less self-supporting than rural/agricultural communities. The food supply/distribution chain becomes longer and more complicated in order to feed urban communities. The drivers to urbanisation are the search for jobs, access to public services and a perceived higher standard of living. Today, 47% of the global population lives in urban communities and this will increase to 60% by 2030. In the EU, 60% of the population already lives in urban centres.

Climate Change and Energy Consumption

Note that a sister factsheet "Saving Energy in Buildings through Thermal Insulation with Polyurethane" (2004) (reference 2) gives details of the impact of climate change and of legislation to combat it. Reference in this factsheet will be confined to a summary.
Full details of the current scientific understanding of climate change can be found in the third report (reference 3) published by the IPCC (Intergovernmental Panel on Climate Change – www.ipcc.org). This report details the history of measurements and observations and also predicts the effects to 2100 and beyond. An update was provided (reference 4) by the World Meteorological Organisation (WMO) in 2003.

Many scientists recommend that action is essential now to prevent catastrophic effects in the not so distant future. Political actions include the Kyoto Protocol which was set up in 1997 and calls for developed countries to reduce the emissions of a basket of six greenhouse gases by 5.2% by 2008/2012 relative to 1990 levels.

The Protocol only applies to developed countries and the USA, amongst others, wants developing countries to be included. The Protocol is expected to be ratified in February 2005. Within the Protocol the EU's target is for a 8% reduction by 2008/2012 relative to 1990. This target is shared by Switzerland. The overall progress towards this target was reported (reference 5) in 2004 which showed that emissions had been reduced by nearly 3% compared to the base year of 1990.



In the EU energy generation and use are recognised as key factors in climate change. There is a Directive (reference 6) aimed at increasing the energy efficiency of buildings which include some buildings in the food chain. The EU, along with other countries, has also recognised the advances that are possible in the energy efficiency of food storage appliances (refrigerators and freezers) and have applied increasingly stringent energy performance standards. These are accompanied by labels which help consumers to select the most efficient models.

THE ROLE OF POLYURETHANE

Polyurethane (PUR) rigid foam has a unique combination of physical/thermal properties and extreme versatility which result in it being an essential component at every step in the food chain. It is not only one of the most efficient thermal insulants available, it is also renowned for rational (cost efficient) production of sandwich constructions. This is a very specific contribution from PUR to the saving of certain resources (not only money but also facing material). The mentioned advantages have resulted in PUR being the predominant insulant and construction element for many of the individual "parts" in the food chain - up to 100% so in some of them.

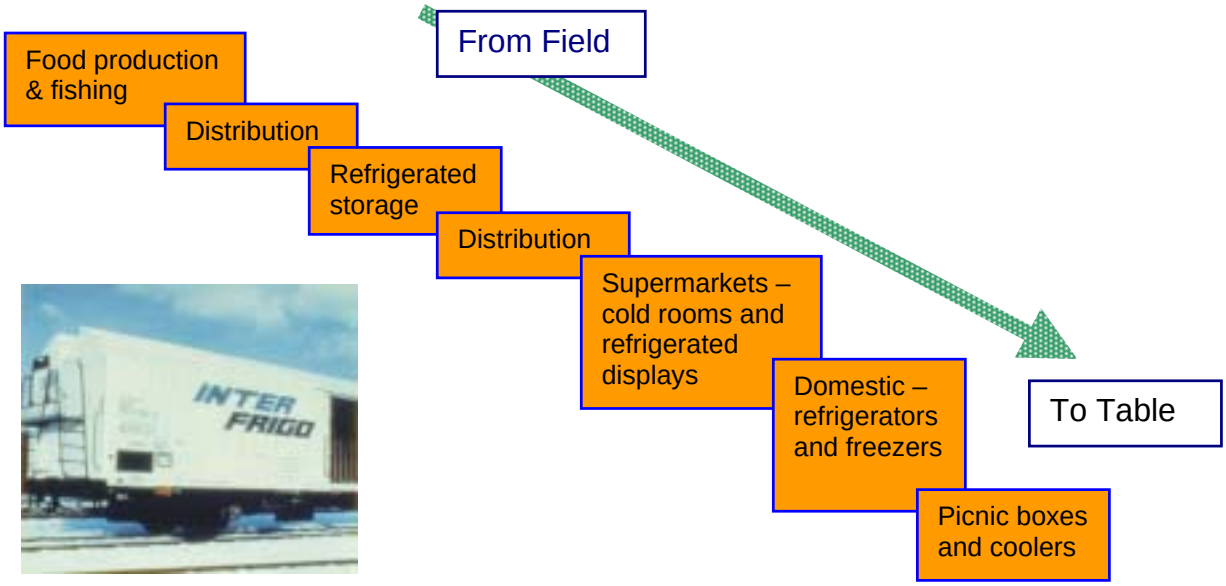
- It has the lowest thermal conductivity of any of the large volume insulation materials, which enables space to be saved by using smaller insulation thickness while achieving the same insulation efficiency as with other materials. This is especially important in space-limited transport applications.

- Its innate strength and self adhesive-capability to a variety of substrate enables cost effective sandwich structures to be produced for applications such as truck bodies, cold stores and refrigerators. Automated production is the norm and the thicknesses of components, such as steel facing materials, can be reduced, resulting in further cost saving.

- In the EU it is made without CFCs or HCFCs and hence does not adversely affect the ozone layer. In many applications the blowing agents are hydrocarbons which have a minimal diect impact on the climate.

THE FOOD SUPPLY CHAIN AND POLYURETHANE APPLICATIONS

A general food chain, starting from food production and continuing to the step before consumption, is illustrated here. PUR plays a role at every stage to ensure that the quality of the food is maintained at minimum energy consumption.



Agriculture/Food Production

PUR is widely used in the insulation of buildings used for rearing chickens. In cold climates it is used for maintaining higher temperatures to help young chickens whilst in hot climates it is used to maintain a cooler atmosphere to promote growth. Fishing vessels now have to fish further from their home ports and holds insulated with PUR keep the catch fresh until it is landed.

Cold stores and Food Processing Building Applications

Fresh vegetables, fruit, butter, milk and various types of meats can be stored before distribution to shops or restaurants in large refrigerated warehouses or cold stores. These buildings are essential to keep year-round stocks of fresh produce. The cold stores are almost always built using steel-faced, PUR-cored sandwich panels. The PUR cores may be 200 mm thick so as to maintain freezing conditions whilst minimising energy consumption. The panels are produced in a continuous process and are commonly 10 m in length. The strength of the panel allows large roof spans to be bridged and the modular panel construction enables these large building to be constructed quickly and maintained with

minimum cost. Similar constructions are also used in many food processing facilities where food is pre-prepared under hygienic conditions.

Food Transport & Distribution

In today's global economy food has to be transported over large distances by sea, rail, road and even by air. The containers (sometimes called reefers) and truck bodies used must be robust to withstand rough treatment, be energy efficient and have highly effective insulation because space is almost invariably limited. Dimensions are standardised and palettes just fit within them. PUR is the standard material used, not only to give insulation but also to contribute to the strength of the container and prolong its service life.

Deliveries from cold stores and distribution centres to supermarkets are almost always by road transport. Truck bodies are usually constructed from PUR-cored panels produced by discontinuous techniques. However, the versatile chemistry of polyurethane also allows insulated bodies to be made from PUR blocks which are sliced into panels and then protective facing are glued to the foam. The floor of the truck is usually made from higher density foam to give extra strength for loading and unloading operations.

Cold Rooms & Display cabinets

Cold rooms are used in large stores and supermarkets to store the fresh and frozen produce for a few days before sale. These rooms are almost always constructed from PUR-cored sandwich panels and are designed for maximum internal space and minimised energy consumption. The panels used in these smaller constructions are usually produced by a discontinuous process which allows the economic production of a variety of shapes and sizes complete with insulated doors.

The supermarket will also have refrigerated cabinets for the display of food. These can be cooled to either refrigerator (+4°C) or freezer (-18°C) temperatures. They will be insulated with PUR to minimise energy consumption. They can be manufactured by either an injection method or constructed using panels similar to those used for cold rooms.

Domestic Refrigerators and Freezers

Domestic refrigerators and freezers are a familiar and invaluable part of the cold food chain. Global annual production is over 80 million units and some 25 million units are sold in the EU each year. Almost 100% of these units are produced with PUR cores. The foaming chemicals are injected in-between the thin steel outer cabinet and thin plastic inner liner and react quickly allowing the unit to be de-jigged in a few minutes. The PUR contributes ease of manufacture, effective insulation and structural strength to the appliance. The high insulation value maximises the internal volume whilst minimising energy consumption.

The huge number of domestic refrigerators and freezers in use has made them a natural target for energy consumption controls in the EU and in many countries around the world. In the EU they consume over 17% of residential energy the Directive 94/2/EC set up the first controls and energy labels (see page 2) give information to the purchaser so that an informed decision can be made. Since 1999 only models satisfying the conditions of Classes A, B and C may be sold (except for some freezers).

The manufacturers of these units have made further developments and lower consumption classifications such as the “energy +”, has been introduced by the manufacturers. This has energy consumption 25% lower than Class A. Further, Directive 2003/66/EC introduced two new levels A+ and A++ which are 25% and 45% more efficient than Class A, respectively.

The energy reduction schemes have been successful in the EU in reducing the average specific energy consumption of refrigerators and freezers by 37% over the period 1992 to 2002.

In addition, eco-labels are also available in many countries to give more information to the purchaser. In the EU, the label is only awarded to appliances which have a class A energy performance. In addition, the foam blowing agent must have a Global Warming Potential (GWP) not exceeding 15. The latter condition is satisfied using the pentane-based technology which is the norm in the EU. All refrigerators with eco-labels are insulated with PUR.

The uptake of eco-labels has been slow, partly of existing mandatory standards and labeling.

This sector is also affected by end-of-life controls and EC 2037/2000 prevents the emissions of CFCs and HCFCs from older models and Directive 2002/96/EC deals with the recycling of refrigerators and freezers.

Picnic boxes and Miscellaneous Applications

A variety of other products used to preserve food and drinks are insulated with PUR and rely on it for strength.

Picnic and cooler boxes are necessary to keep food fresh for work or leisure. Drinks/liquid containers are be used to keep their contents hot or cold.

Commercial drinks vending machines use PUR insulation so that energy consumption is minimised

Conclusions

This factsheet shows the invaluable role played by PUR throughout the food chain. Its processing versatility makes it suitable for a wide range of applications, its structural strength is relied upon for a variety of cost effective structures and, most importantly, its insulating properties help to reduce energy consumption.

The demand for food will grow and PUR will be in an even higher demand to help feed the world.

References

Reference 1: The World Bank Atlas 2003
Reference 2: ISOPA 2/2004 www.isopa.org
Reference 3: IPPC Third Assessment Report; Climate Change 2001
Reference 4: WMO Press Release (WMO-No 702); December 2003
Reference 5: European Environment Agency 15/07/2004
Reference 6: Directive 2002/91/EC on the energy performance of buildings

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