



Research News

Quest: vast reductions of CO₂ emissions of reefer containers

Quest software, designed by Agrotechnology & Food Innovations (A&F), reduces the energy requirement of reefer containers by up to 50%.

Reducing carbon emissions

All over the world, hundreds of thousands of reefers with cargo loads of bananas, grapes, apples and other perishables are shipped every year. Although transport over sea is much more environmentally friendly than air transport, keeping these perishables at their required low temperature still contributes to the “carbon footprint” of perishables. Quest significantly reduces the power consumption of reefer containers, while product quality stays optimal. Using the new Quest power saving software reduces both operating costs and carbon emissions. Quest helps fight global warming.

The EET project Quest

Quest stands for ‘quality and energy efficiency in storage and transport of agro-materials’. The Quest software

design is one of the results of the joint research project QUEST (2002-2005). A&F initiated the Quest project to develop new climate control concepts for perishable products, aiming at the reduction of energy use and optimisation of product quality; for reefer transport and on-land storage. The consortium partners each funded their own research effort, supported by a grant of the Dutch Economy Ecology Technology programme (EET).

The Quest principle

A reefer unit is designed to both freeze and cool. Therefore it works less efficient in part load, such as when cooling fruit or vegetables. The Quest software design uses the compressor at a higher efficiency by intelligently cycling on and off in perishable mode. The resulting temperature fluctuations are dampened by packaging and the slow response of produce metabolic processes. The Quest software design includes carefully designed temperature limits and settings, which

keep produce at correct temperature, so that the quality is not harmed. Different settings have been found for various product classes and are designed dependent on setpoint, i.e. easy to operate.

The Quest control logic

The Quest control logic can best be explained using the graphs below.

The first graph explains that Quest starts after pull down. At the start of a trip, the reefer unit first starts cooling down the supply air until it reaches the requested setpoint. It then keeps on cooling with this supply air temperature until the return air temperature drops below the pull down limit.

The second graph shows what happens when Quest starts. The supply air is temporarily allowed to drop below the setpoint, so that the unit can cool at a higher efficiency. To protect the produce, the supply air is limited by the supply air low limit. Also the return air is limited, by the “return air low limit”. Once the return air reaches this temperature limit, the compressor is stopped and the air temperatures is allowed to naturally increase up to the “return air high limit”. During this period the fans run on low speed to be able to continue monitoring the return air temperature.

The third graph shows how the cycling continues. The compressor is started again after the return air high





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limit" is reached. And at the same time the fans are set to high speed again.

The fourth graph shows the effect of the fluctuations to the temperature inside the carton. Measurements in hundreds of cartons have shown that the fluctuations are dampened almost completely by the cartons, i.e. the produce only "sees" the average temperature, which is the same as in a normal shipment.

Quest experiments

Extensive product quality research was performed to find and check the Quest settings. Produce quality was tested in lab scale tests, on-land full scale tests and dozens of real life trial

shipments. The tests have shown that energy savings of up to 50% are possible, while the temperature fluctuations do not affect produce quality compared to normal mode. E.g. a 40' trial container fully loaded with mandarins showed a power usage reduction of 53%, reducing from 5.6 to 2.7 kW.

Quest implementation

In 2006 and 2007 the Quest software was further developed and tested by A&F, Carrier and Maersk Line. A&F has fine-tuned the software design; Carrier has introduced its Quest power saving software to the market and Maersk Line has implemented it into its reefer fleet. Maersk Line estimates that a reduction of

380,000 tons of CO₂ emission per year will be achieved in 2009. Such savings are comparable to the CO₂ emission of 2.3 billion car km's or the effect of replacing 1.9 million light bulbs by power saving lamps. An enormous effect!

With the appropriate license of A&F, other reefer manufacturers and shippers can now also introduce Quest and benefit from its power savings.

More information

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