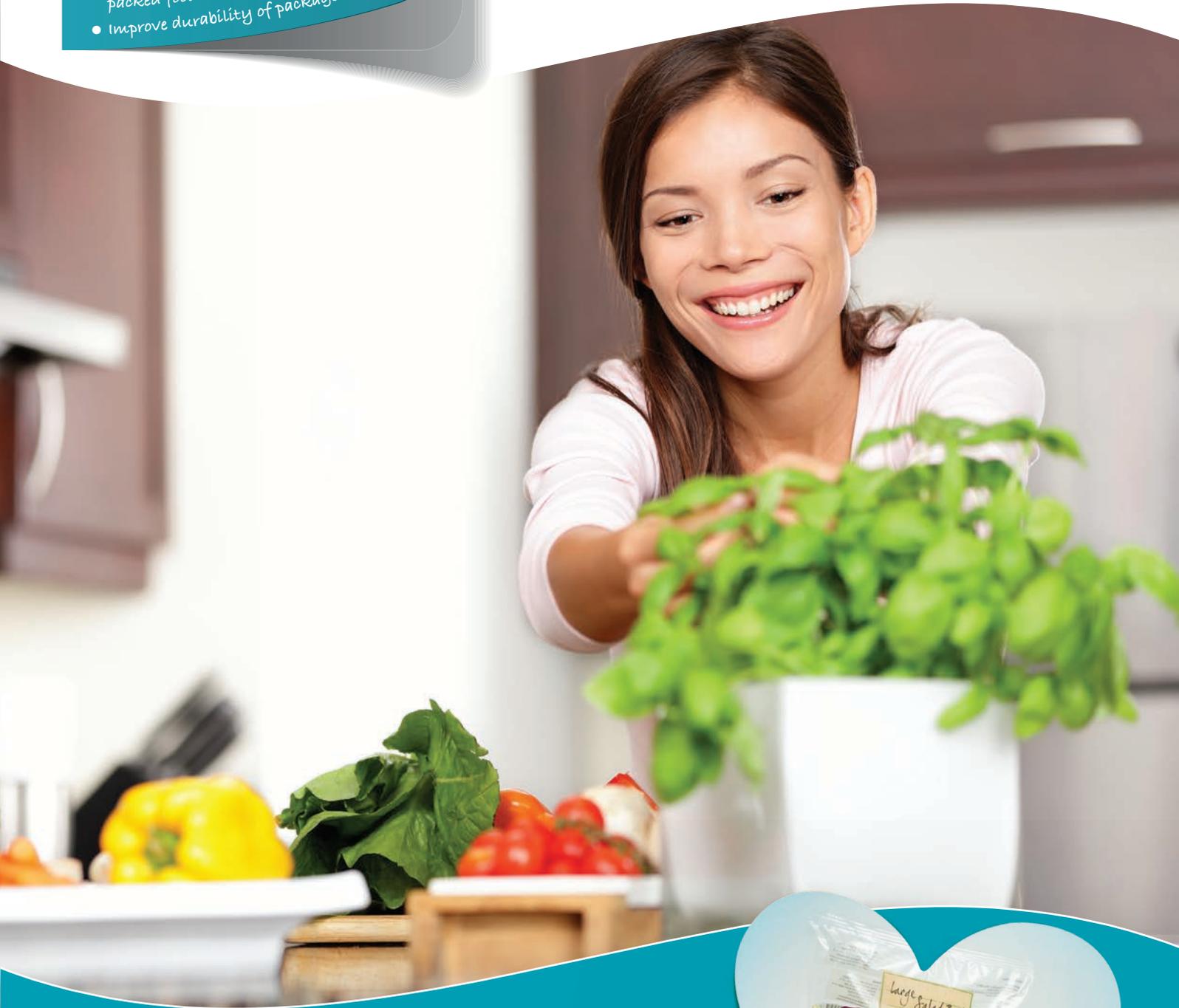


Reasons to buy

- Increase light transmission in agricultural films
- Improve aesthetics of chilled and hot packed food
- Improve durability of packaged contents

Atmer™ anti-fog

Performance you can clearly see



CRODA
Polymer Additives

At the heart of better plastics

Atmer™ anti-fog

Performance you can clearly see

Croda Polymer Additives is well known for providing migratory additives for a range of benefits which include slip, anti-fog and anti-static. Croda's long history of surfactant manufacture means it is well placed to choose the best performing chemistries for applications as varied as agricultural films to retail packaging.

The Atmer range of anti-fog additives is no exception with many different technologies and physical forms being offered to provide the required fog reduction for different processes. Croda's anti-fogging additives can be incorporated into the polymer internally during the extrusion process. They migrate to the surface allowing the condensed water droplets to spread into a continuous and uniform transparent layer on the fabricated film.

Fogging in plastic films

Fogging is a term used to describe the formation of small discrete droplets of water on the surface of transparent plastic films. Fogging most commonly occurs when there is a temperature differential between the inside and the outside of an enclosed atmosphere causing localised cooling at the interface.

Fog formation in food wrapping film obscures the contents, significantly reducing the aesthetic quality of the packaged food. In agricultural films it can lead to reduced light transmission with a consequent reduction in growth and crop yield. It can also cause damage to the plants due to burning from a 'lens' effect and from continuous water drip.

Stand Out

Keep packaged food looking good

Packaged foods can contain large amounts of moisture which causes condensation on the inside of packaging.

This can make food less appealing to shoppers and in a competitive retail environment food needs to look pristine in order to stand out on supermarket shelves.

Atmer anti-fogging additives prevent fog build up on the inside of packages, improving aesthetics and durability of chilled and hot foods.



Feeding the growing population

As the global population continues to rise, so too does the demand for food. Agricultural land for food crops is now in competition with land for bio-fuels and increasing urbanisation, meaning today's farmers are under pressure to produce more food from less land. Atmer anti-fogging additives improve light transmission in polytunnels leading to increased growth rates and crop yields.



Without anti-fog small droplets reflect light resulting in slower growth and ripening

Larger droplets drip and can focus light causing plant damage

Good anti-fog will result in a thin film of water which will drain away without dripping resulting in maximum light transmission with minimal plant damage

Product range

The Atmer range includes a wide variety of additives for use in both food wrap and agricultural films. In addition to pure products, Atmer anti-fogging agents are also available as concentrates in a polymer carrier.

Trade name	Description	Physical form at 25°C	Raw material origin	Recommended uses
Anti-fog food wrap				
Atmer 121	Glycerol ester	Liquid	Non-vegetable	PE, EVA, PVC food wrap
Atmer 1006*	Glycerol ester	Liquid	Vegetable	PE and EVA food wrap
Atmer 1010†	Glycerol ester	Paste	Vegetable	Cling in food wrap used in conjunction with Atmer 116
Atmer 1440	Glycerol ester	Paste	Non-vegetable	Polyolefin food wrap
Atmer 100	Sorbitan ester	Liquid	Vegetable	PE and EVA food wrap
Atmer 116	Ethoxylated sorbitan ester	Liquid	Vegetable/ Synthetic	Food wrap in conjunction with Atmer 1010
Atmer 645†	Proprietary blend	Liquid	Vegetable/ Synthetic	PE, EVA, PVC food wrap
Atmer 674†	Proprietary blend	Liquid	Vegetable/ Synthetic	PE, EVA, PVC food wrap
Atmer 688†	Proprietary blend	Liquid	Vegetable/ Synthetic	PE, EVA, PVC food wrap
Atmer 7340	20% concentrate in polyethylene	Pellet	Non-vegetable	Clear food wrap applications
Atmer 7373	40% concentrate in polypropylene	Pellet	Non-vegetable	Long lasting benefits in polypropylene
Anti-fog agricultural film				
Atmer 185	Glycerol ester	Microbead	Vegetable	Agricultural films especially EVA
Atmer 103	Sorbitan ester	Microbead	Vegetable/ Non-vegetable†	LDPE and PVC agricultural films
Atmer 7301	50% concentrate in polyethylene	Pellet	Vegetable	Long lasting benefits in agricultural films
Atmer 7326	50% concentrate in universal polyolefin carrier	Pellet	Vegetable	Long lasting benefits in greenhouse films particularly triple layer films

*Only available for supply in Asia †Only available for supply in USA

Product physical forms

Atmer anti-fog products are available in up to four physical forms. Please check with your local sales contact for availability in your region.



Applications

Agricultural films

Agricultural film poses an extreme challenge for anti-fogging additives with the key factor being longevity of performance. Additives have to be designed to migrate to the surface more slowly and be compatible with the polymer matrix in order to slow the rate of extraction during the service life of the film. Different climate conditions also need to be considered as a change of additive and usage levels may be required.

The use of anti-fogging additives in agricultural film causes condensed water droplets to spread into a thin continuous layer of water, which:

- Improves light transmission resulting in higher plant growth rates, higher crop yields per plant and earlier crop maturity
- Reduces burning of plants and crop spoilage
- Reduces constant water dripping

Polyethylene mono layer films

For mono layer agricultural films, the limit of film performance is typically around 12 months. Atmer 103 is recommended for use in LDPE and LLDPE based formulations.

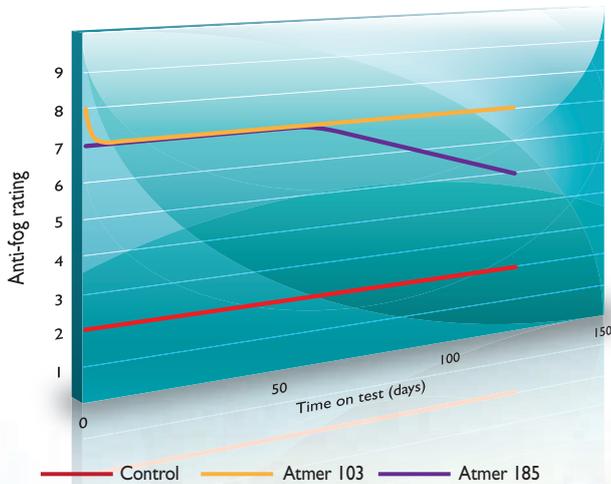


Figure 1: Comparative anti-fog performance of Atmer 103 & Atmer 185 – accelerated greenhouse test LDPE film (180µm) 2% additive

EVA mono layer films

Atmer 103 can also be used for low vinyl acetate (VA) content EVA films. For higher VA content EVA, Atmer 185 provides improved performance over Atmer 103.

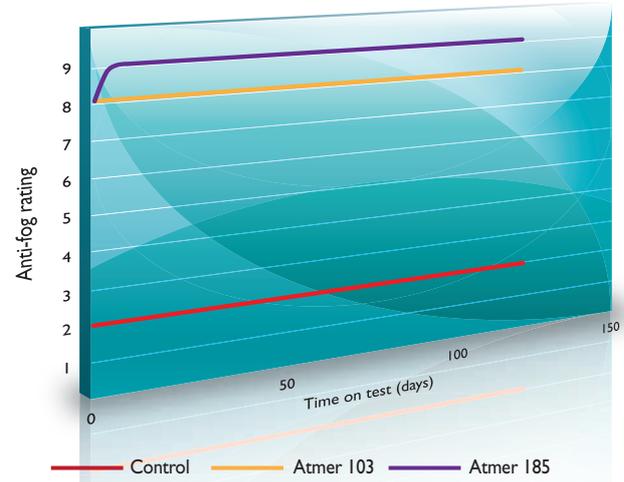


Figure 2: Comparative anti-fog performance of Atmer 103 & Atmer 185 – accelerated greenhouse test EVA film (4% VA, 180µm) 2% additive

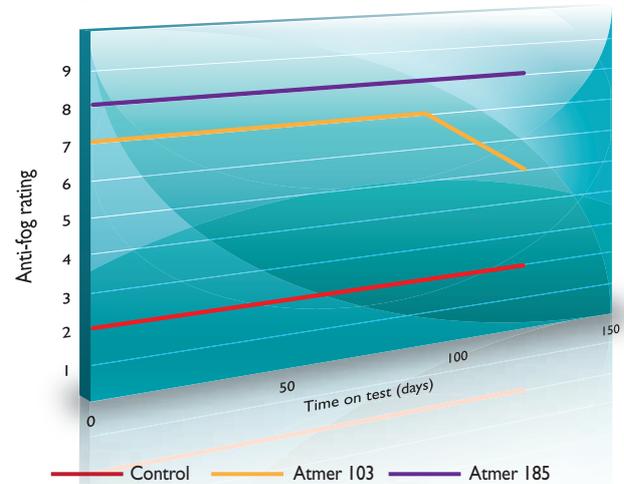
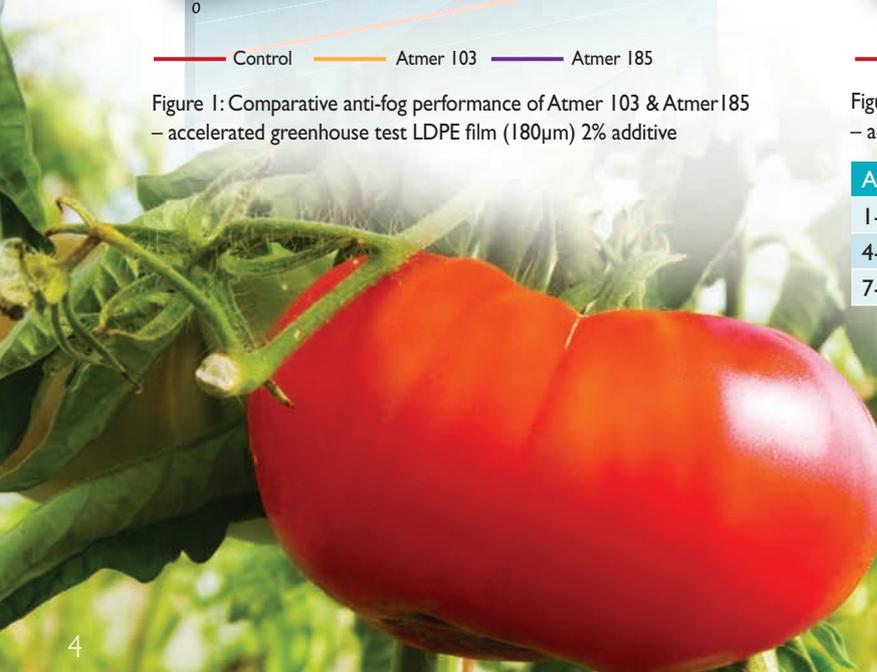


Figure 3: Comparative anti-fog performance of Atmer 103 & Atmer 185 – accelerated greenhouse test EVA film (18% VA, 180µm) 2% additive

Anti-fog performance scale	
1-3	No anti-fogging performance
4-6	Moderate anti-fogging performance
7-9	Good anti-fogging performance



Multi layer co-extruded films

Modern, long-lasting agricultural films commonly use a co-extruded structure to further enhance their properties. Typically these structures are employed to allow the use of the core layer of the structure to achieve a controlled release effect of the anti-fogging additive to the surface of the film. This layer will be highly loaded, usually around 5% active with a lower 1% active used in the inside skin layer. For ultimate longevity, Atmer 7326 is recommended for this type of film.



Figure 4: Cross section of three layer co-extruded film.

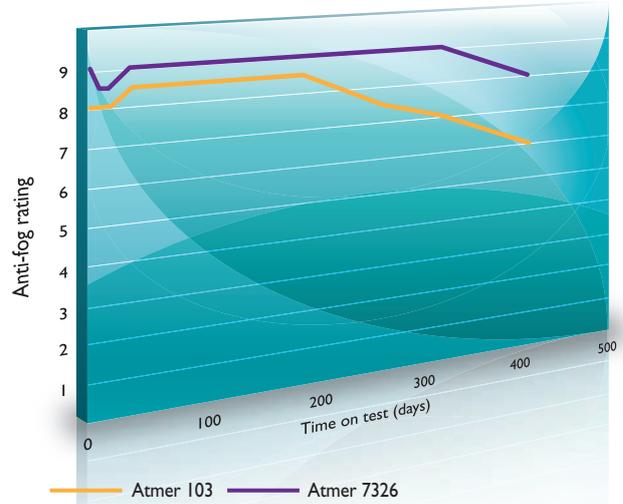


Figure 5: Comparative anti-fog performance of Atmer 103 & Atmer 7326 – accelerated greenhouse test three layer co-extruded film 2% additive

Case Study

Improve light transmission in LDPE agri-film

With the increasing demand for food from the growing population, Croda was approached by a supplier of agri-film to a tomato grower requiring improved light transmission in greenhouse tunnels in an attempt to increase crop yields. Poor light transmission in greenhouse tunnels is caused by water droplets forming on the inside surface of the film. Water appears as discrete droplets due to differences in the surface tension between the water droplet and the polymer surface. This not only causes a reduction in light transmission but also considerable damage to the crop through constant water drip and also through burning, since water droplets act as lenses when sunlight shines through them.

Croda supplied the film manufacturer with Atmer 103, a specially formulated anti-fogging additive recommended for LDPE agricultural films. Having been incorporated into the polymer at 2% active level, Atmer 103 improved light transmission through the film by almost 50%, spreading condensed water droplets into a thin transparent layer of water on the surface of the film.

A reduction in the amount of damaged fruit was also observed. In the previous season's growth, 17 pieces of damaged fruit were observed, however just 7 were observed in the crop grown with the inclusion of Atmer 103 – a reduction of almost 60%. The ripening rates of the tomatoes also increased significantly each day. Over a 25 day period, there was a 26% increase in the amount of ripe fruit collected compared to the previous season.

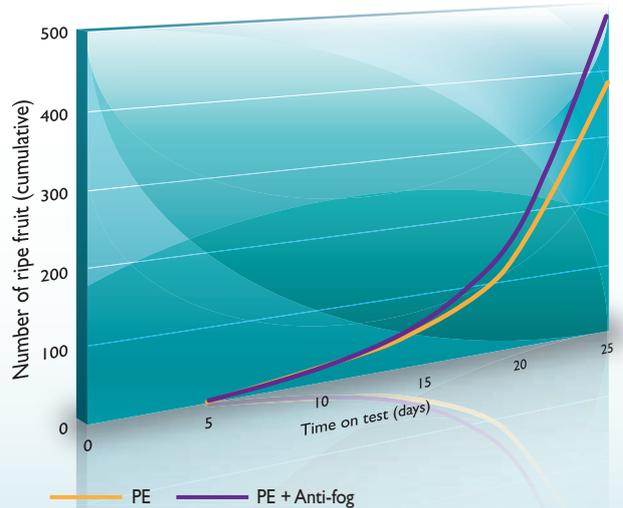


Figure 6: Increased ripening rates of tomatoes when using 2% Atmer 103 in LDPE greenhouse film

Applications

Food wrap film

By adding a suitable anti-fogging additive to food wrap film, condensed water droplets are spread into a thin continuous layer improving the transparency of the packaging and the durability of the contents. This also improves the presentation of the food to look more appealing to customers.

In general, food wrap applications require short term anti-fogging performance lasting only the lifetime of the packaged food.

Polyethylene mono layer films

Atmer 1440 and Atmer 100 are preferred for polyethylene films at a use level of 0.5 – 1.0%.



Food packaging with and without anti-fog

Polypropylene

Atmer 7373 is recommended for polypropylene film at a use level of 2-5%.

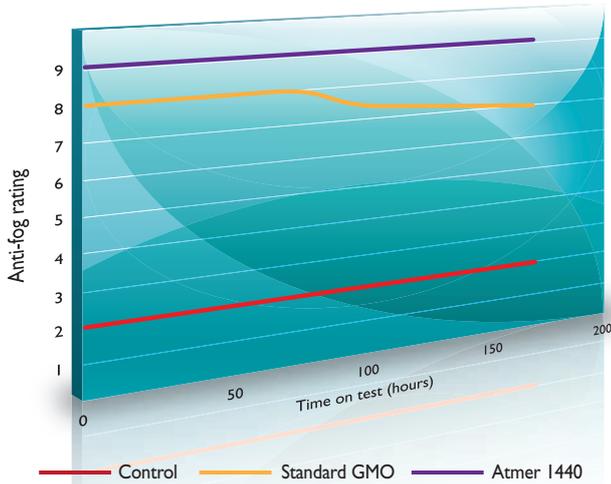


Figure 7: Comparative anti-fog performance of Atmer 1440 - cold fog test LDPE film (50µm) 1% additive

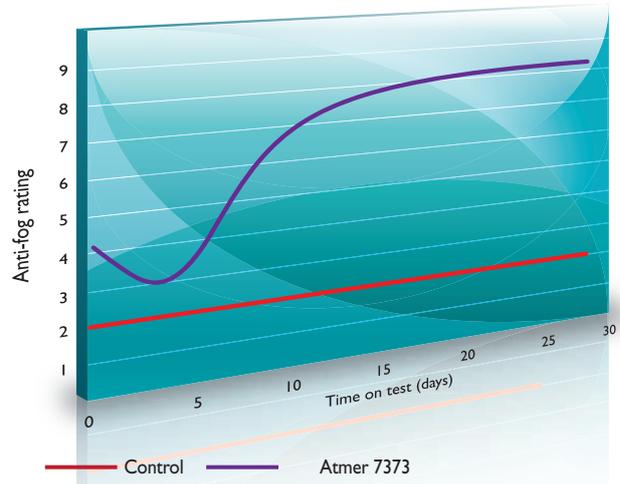


Figure 9: Comparative anti-fog performance of Atmer 7373 - cold fog test PP homopolymer film (50µm) 3.75% additive

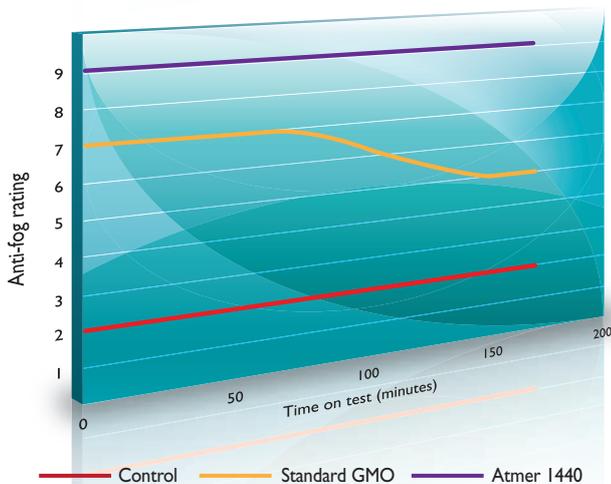


Figure 8: Comparative anti-fog performance of Atmer 1440 - hot fog test LDPE film (50µm) 1% additive

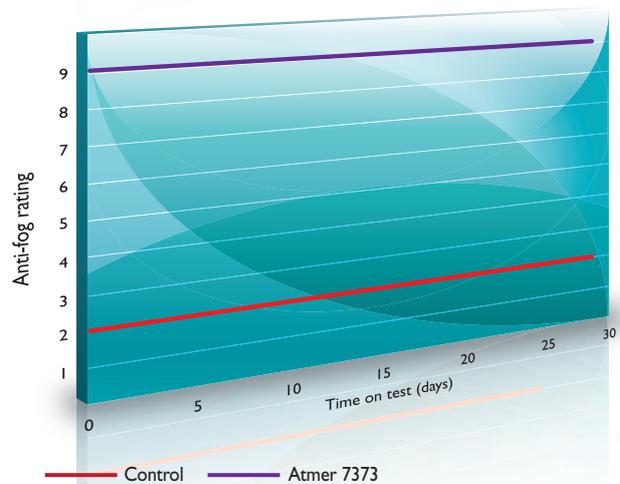


Figure 10: Comparative anti-fog performance of Atmer 7373 - hot fog test PP homopolymer film (50µm) 3.75% additive



Externally applied anti-fogging agents

Some film structures are not amenable to using migratory additives e.g. PET. In this situation, for short term anti-fog performance in food wrap the best solution is to apply an external coating of Atmer 116 or Atmer 110. It should be dissolved in an appropriate solvent such as water or isopropyl alcohol, typically at concentrations of 1-5%. It can be applied by spraying, wet coating or dipping, depending upon the product and manufacturing process. Quantities depend upon surface area and typical requirements range from 50-200mg/m² of active.

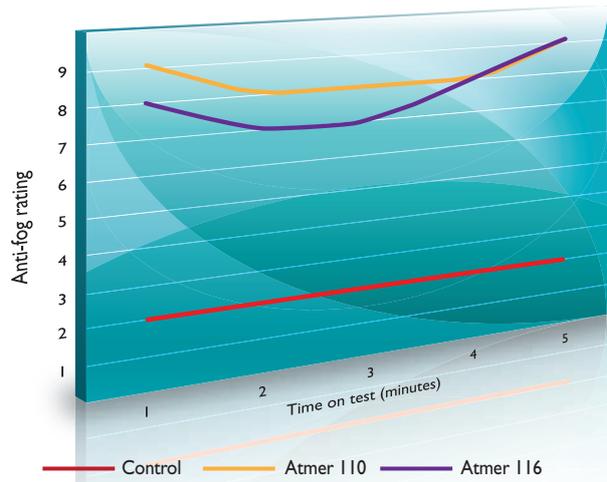


Figure 11: Comparative anti-fog performance of Atmer 110 and Atmer 116 – hot fog test in PET film

Case Study

Improved fogging performance in polypropylene packaging

Croda was approached by a polypropylene film manufacturer, supplying packaging for refrigerated salads in supermarkets. Using an alternative glycerol based anti-fog the supplier found that performance under cold fog conditions was especially poor, and that their customers were complaining about poor sales due to fog formation. Fog formation can mislead consumers into believing that products have been on display for a long period or are faulty making them appear unattractive.

Croda supplied the manufacturer with Atmer 7373, a specially formulated anti-fog for polypropylene. Having been incorporated into the polymer at 3.75%, Atmer 7373 dramatically reduced the amount of fog forming on the packaging. Over 95% of packages showed complete clarity and no droplet build up, with water droplets spread evenly in a continuous layer across the film when compared to glycerol based anti-fogs.

The supplier also noted that when Atmer 7373 was incorporated into the film, uniform performance was achieved irrespective of position within the cabinet when compared to a glycerol based anti-fog.



Questions?

To find out more about Croda products and optimising anti-fog performance please contact your nearest regional office or visit www.croda.com/pa

Further information

Croda sales and distribution are coordinated through an extensive worldwide network of associates and agents. For details of your local representative please contact your nearest Croda regional office.

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