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PRODUCT STEWARDSHIP SUMMARY

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ETHANOX® Antioxidants, ETHAPHOS® Antioxidants ALBlend® Polymer Additive Blends

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Introduction

Albemarle Corporation provides several products as antioxidants and additive blends for use in polymers such as plastic, adhesives and elastomers. ETHANOX and ETHAPHOS antioxidants maintain performance integrity and processing stability of plastics, elastomers, adhesives and other materials. ALBlend “antioxidant blends” are the combinations of sterically hindered phenols (i.e., ETHANOX) and phosphites (ETHAPHOS). ETHANOX antioxidants act as free radical scavengers and the ETHAPHOS antioxidants act as hydroperoxide decomposers in the polymers respectively. The polymer antioxidants include ETHANOX 310, ETHANOX 314, ETHANOX 330, ETHANOX 376, ETHANOX 323A, ETHAPHOS 326, ETHAPHOS 368, and the blends comprise of ALBlend 181, and ALBlend 182.

ETHANOX, ETHAPHOS and ALBlends are a family of antioxidants used as oxidation inhibitors for a variety of polymer products. The ETHAPHOS and ALBlend products, and all ETHANOX antioxidants except ETHANOX 323A are acceptable for use in food contact applications regulated by the US Food and Drug Administration. Several of these products also have food contact clearances in the European Union, Japan



and China. This means they can be used to manufacture packaging materials, plastics and coatings that come in contact with food, such as plastic trays, bags, and wrappers.

Description and Properties

All of the ETHANOX, ETHAPHOS and ALBlend products, except for ETHANOX 323A, are white to off-white powders, granules or pellets. ETHANOX 323A is a brown viscous liquid. All of the products are organic based, characterized with a phenolic component. They also have a low solubility in water.

Uses

ETHANOX and ETHAPHOS antioxidants and ALBlend additive blends are safe and effective for use in a wide variety of polymers, from thermoplastic elastomers and engineering plastics and alloys, to hot melt adhesives and tackifiers, as well as polyolefins. The effectiveness of the antioxidants and ALBlends allows their use in a wide range of polymer processes. They prevent degradation of the polymers during polymer processing. They improve the polymer stability, quality and appearance. Polymers



manufactured with ETHANOX, ETHAPHOS and ALBlend products are better suited to demanding and long-term end-use applications.

Albemarle's antioxidants play an important role in the manufacture of many polymers and resins used in sheet, injection and blow molding applications. Polymers generally go through several processing steps on their way to their final form. At each process, oxidation of the polymer can occur. This leads to degradation of the polymer. The ETHANOX family of hindered phenolic antioxidants and ETHAPHOS family of phosphites work synergistically to protect the polymers from oxidative degradation during processing and end-use.



ETHANOX and ETHAPHOS antioxidants and ALBlend additive blends are used in the manufacture of specialized products in a wide range of industries that include food and medical packaging, automotive, mining, construction and agriculture. Combinations of ETHANOX/ETHAPHOS antioxidants are used to stabilize polypropylene resins for various applications including general-purpose injection molding, thin/thick wall containers, caps/closures, films, fibers, profile extrusion, sheet/thermoforming, automotive and durable appliances. For example: ETHANOX 330 is an

antioxidant of choice for Polyolefin water pipe applications because of its resistance to hydrolysis and water extraction. Also, it is used in stabilizing polypropylenes for medical/disposable packaging due to its non-toxicity, and non-extractability features.

ETHANOX 323A antioxidant is a convenient and inexpensive way to enhance the commercial value of tall oil, gum and wood rosins and their derivatives. ETHANOX 323A antioxidant enables the economical and efficient production of lighter colored rosins and rosin esters needed by the expanding markets for clear coatings (varnishes) and adhesive tackifiers. Tackifiers are a unique class of materials used to modify both performance and processing properties of the adhesives. Tackifiers make these materials useful for imparting "tack" and desirable viscoelastic properties in the formulation of hot melt and pressure sensitive adhesives. ETHANOX 323A is effective in improving the color of rosins by acting as a catalyst to convert relatively unusable materials to more stable rosins. These rosins can be used in adhesives, rubbers, inks and as emulsifiers.

ALBlend free-flowing blends eliminate the feeding and transfer problems associated with some additive forms. They eliminate the need to pre-blend or master-batch antioxidants. This means reduced additives handling,



as well as improved stabilization during compounding and in end-use applications. The result is less downtime for clean-up, and higher equipment operating efficiency. These products are free-flowing pellets that are easy to handle. In addition, dusting is minimized, helping you improve workplace hygiene.

Health Information

The ETHANOX and ETHAPHOS polymer antioxidants and ALBlend additives have a fairly low toxicity as a group. At worst some of the products are irritants, showing effects to the skin and/or eyes. Exercise good personal hygiene when handling these materials.

Please consult the product Material Safety Data Sheet for recommended personal protective equipment and further information.

Exposure Potential

None of the ETHANOX, ETHAPHOS or ALBlend antioxidants have exposure limits established by OSHA or other organizations. A component of the liquid ETHANOX 323A has an exposure limit. For that product, workplace monitoring must be conducted to ensure that workers are not overexposed to the component that has a limit established. For the powdered products, we highly recommend that handlers use

the OSHA personal exposure limit for particles not otherwise classified. This limit is listed on our material safety data sheets. Good industrial hygiene practices and normal industrial precautionary measures to prevent contact and/or dusting should minimize the health risk when handling these products. In addition to eye protection, workers should use protective gloves and protective clothing when skin contact or clothing contamination is possible. The use of a NIOSH approved respirator is also recommended when handling powder or crystalline materials. It is recommended that the product be handled in a well-ventilated area.

ETHANOX and ETHAPHOS antioxidants and ALBlend additives are used at varying percentages depending upon the polymer and specific application but usually varies from 0.025 to 0.5 weight percent. Since these antioxidants are well dispersed in the plastic matrices, the exposure to the antioxidants or blends from using polymers is minimal.

Please consult the product Material Safety Data Sheet for recommended personal protective equipment and further information.

Environmental Information

ETHANOX and ETHAPHOS polymer antioxidants as well as the ALBlend products are not toxic to aquatic organisms and therefore do not have any direct impact on the environment when properly used for their intended purposes.



These products are not regulated as hazardous wastes or materials. If spilled, waste containing uncured product should be disposed of according to good waste management practices and in compliance with applicable local, state, and federal regulations.

With proper handling in transportation, storage and use, release to public waters such as lakes, streams ponds and oceans, is not expected.

Physical Hazards

The ETHANOX polymer antioxidants are all stable additives under normal handling and storage conditions. High temperatures and sources of ignition, as well as acids, bases, oxidizing and reducing agents should be avoided.

Derivation/Manufacturing

Albemarle manufactures the ETHANOX and ETHAPHOS polymer antioxidants at several different locations such as Orangeburg, SC, as well as Ningbo and Jinshan, China.

Regulatory Information

None of the ETHANOX or ETHAPHOS polymer antioxidants or ALBlend products is regulated for transport purposes.

All of the ETHANOX and ETHAPHOS polymer antioxidants and ALBlend products are in compliance with the Toxic Substances Control Act (TSCA) and some are also in compliance with other international countries' chemical inventories.

They are neither controlled under the Canadian Workplace Hazardous Material Information System (WHMIS) nor they are required to be labeled as Class D materials in Division 2B.

The Emergency Planning and Community Right-to-Know Act (also known as SARA Title III or EPCRA) classifies most of the ETHANOX and ETHAPHOS antioxidants and the ALBlend additives as being physical hazards and/or acute hazards.

Three ETHANOX antioxidants have not been assigned any SARA 311/312 hazard category.

Under the European "REACH" regulation, Albemarle Europe SPRL, acting as the importer, has pre-registered the components of the ETHANOX and ETHAPHOS polymer antioxidants and ALBlend Products. Albemarle is deeply involved in Industry activities to ensure timely registrations with deadlines depending on volume threshold put on the market and/or substance characteristics.

Product Stewardship

Albemarle is committed to managing the ETHANOX and ETHAPHOS antioxidants and ALBlend additives so our customers use them safely. Our relationships with our customers encourage communication about safety and environmental stewardship, and we work with them to minimize the risks of personnel exposure and spills.

Albemarle is staffed and organized to investigate and provide advice regarding appropriate corrective actions if such incidents occur.

Conclusion

Plastics have developed rapidly in the last several decades to a point where they have become fundamental materials for everyday living. Improving the plastic manufacturing processes means these materials are being used instead of glass, metal, paper

and wood. ETHANOX, ETHAPHOS polymer antioxidants and ALBlend additives play a very important role in the recent advances in plastic manufacturing and processing. They improve manufacturing process and reduce costs for many important polymers by protecting the polymers from degradation during processing and end-use.

Note

This document provides general information about ETHANOX, ETHAPHOS and ALBlend products and does not supplant or replace required regulatory and/or legal communication documents, nor it is intended to provide an in-depth discussion of health and safety information. Always consult the products' Material Safety Data Sheets, product labels and technical data sheets before using these chemicals.



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