

ACID COPOLYMERS AND IONOMERS

**North America, Europe and Asia
Markets, Technologies and Trends 2000-2005**

**Prospectus For
An In-Depth Market/End-Use Economics Study**

Completed August 2001

**Global Market Size & Growth Rates, by Region, by End Use
Acid Copolymers (EAA, EMAA), Specialty (EMA, EEA,
EnBA) and Ionomers**

Technology Overview and Patent Related Issues

Major End Uses and End Users, Suppliers/Grades

**Supplier Profiles and Market/Technology Position of Major
Suppliers**

Manufacturing Cost Analysis

Multi-attribute Analysis by End Use

Future Direction by End Use and Major Participants

**Comparison of Acid Copolymers & Ionomers with
Plastomers**



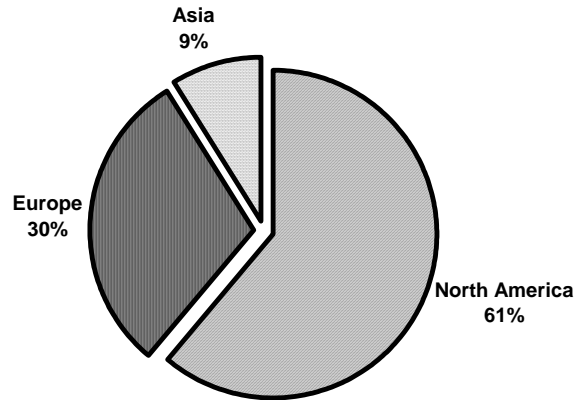
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Exhibit 1

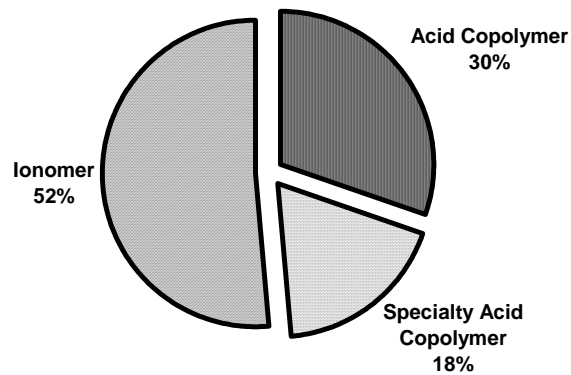
GLOBAL DEMAND FOR ACID COPOLYMERS & IONOMERS BY REGION



Global Demand for Acid Copolymers & Ionomers, 2000 = 585 MM Lbs.

Exhibit 2

GLOBAL DEMAND FOR ACID COPOLYMERS & IONOMERS BY TYPE



Global Demand for Acid Copolymers & Ionomers, 2000 = 585 MM Lbs.

ACID COPOLYMERS AND IONOMERS

North America, Europe and Asia Markets, Technologies and Trends 2000-2005

INDUSTRY OVERVIEW

Acid Copolymers and ionomers have largely evolved over the years. The industry has enjoyed substantial growth rates in various end use applications such as packaging, sporting goods, and automotive applications. Their low seal initiation temperatures, hot tack strength and tackiness are the key to its major applications.

Copolymers of ethylene and acrylic acid or methacrylic acid are commonly referred to as "acid copolymers". Acid copolymers are polar in nature and used in various applications requiring adhesion of polyolefins to polar substrates. Acid copolymers provide superior hot tack and heat seal properties. The acid content generally ranges from 3% -20%. The major end use applications for acid copolymers include aseptic packaging, squeeze tube packaging, condiment packaging, carpet backing, wire and cable, medical packaging, dry fruits packaging, hair care, and snack packaging. Copolymers of ethylene with methacrylic acid are called ethylene methacrylic acid. They are also used for all the above applications, though their use is limited. Ethylene methacrylic acid is mainly used as an intermediate for producing ionomers.

Ethylene ethyl acrylate (EEA), ethylene methyl acrylate (EMA) and ethylene n-butyl acrylate (EnBA) are collectively called as specialty acid copolymers in this study. EEA is a copolymer of ethylene and ethyl acrylate. The polymer exhibits high flexibility, excellent impact and tear resistance. These properties are dependent on the content of ethyl acrylate and can be changed by varying the acrylate content in the copolymer. The major application areas for EEA are wire and cable, adhesives, flexible packaging and nylon compounding. EMA is a copolymer of ethylene and methyl acrylate. Its major applications include food packaging, heat-shrink tubing and in disposable gloves. Thermal stability, soft feel, flexibility and heat seal response at lower temperatures are some of its prominent properties. EnBA is a copolymer of ethylene and n-butyl acrylate. It is essentially used as films or for coating applications. The most common applications are in thermal laminating, frozen food packaging and meat packaging.

Ionomers are thermoplastic polymers that are ionically crosslinked, containing both hydrogen and ionic bonds. They are derived from ethylene/methacrylic acid copolymers. The copolymers are neutralized with either sodium or zinc. The most important applications for ionomers are in the manufacture of films and extrusion coatings used primarily for various kinds of food packaging. Ionomers have multiple applications within the injection molded, film, and extrusion markets. The major markets for ionomers include meat packaging, skin packaging, medical packaging, automotive injection molding, golf ball covers, condiment packaging, squeeze tube packaging, aseptic brick packaging, nuts and dried fruit packaging, bowling pin covers, bullet proof glass, hair care products packaging, and snack food packaging.

BENCHMARK STUDY

To assist companies in understanding the current market status and help them monitor the rapid developments within the industry, Chemical Market Resources, Inc. (CMR), presents **ACID COPOLYMERS AND IONOMERS 2000-2005, North America, Europe and Asia**, part of the **Markets, Technologies and Trends Series**. CMR has extensive experience in packaging-related markets. This study represents a comprehensive report with focus on business/technical strategic analysis and includes an in-depth analysis of the intermaterial competition of these products/markets. The overall report will help in assessing opportunities and strategies for further development of this specialty polyolefin market.

HISTORY

The technology for manufacturing acid copolymers and ionomers was developed in late 60s by DuPont. Other significant contributors to this technology include: (1) Dow, (2) ExxonMobil, (3) Chevron-Phillips, and (4) Union Carbide (now Dow). This industry has seen its share of litigation for domination in the industry through patents. DuPont apparently emerged as the winner gaining the patents for the manufacture of acid copolymers and ionomers. Dow obtained exclusive rights for the manufacturing of acid copolymers and its conversion to ionomers. Thus the groundwork for the domination of the industry by limited suppliers was laid with the issuance of patents. The technology has significantly evolved from applications like golf ball covers and bowling pins (applications based on properties like impact strength) to packaging applications (applications based on properties like low seal initiation temperature and hot tack properties). This journey from sporting goods applications to packaging markets was supported by continuously increasing demand.

Acid copolymers and ionomers include: (1) ethylene acrylic acid (EAA), (2) ethylene methacrylic acid (EMAA), (3) ethylene ethyl acrylate (EEA), (4) ethylene methyl acrylate (EMA), (5) ethylene n-butyl acrylate (EnBA), and (6) ionomers. Acid copolymers are the copolymers of ethylene and acrylic acid, while ionomers are the salts of acid copolymers formed by neutralizing acid copolymers with zinc or sodium.

The major end-use markets for acid copolymers and ionomers include (1) vacuum packed processed meat packaging, (2) snack food packaging, (3) squeeze tube packaging, (4) wire and cable, (5) automotive applications, (6) impact modifier for nylon, (7) golf ball and bowling pin covers, and others. Acid copolymers and ionomers have grown uniformly in major markets over the years.

The total global demand for acid copolymers and ionomers in 2000 was 585 million pounds. North America constituted about 61% of the global demand, Europe 30%, and Asia 9%. The North American demand for acid copolymers and ionomers is projected to grow at the rate of 5.3% annually for the next five years. The European and Asia demand for acid copolymers and ionomers over the next five years is expected to increase at the rate of 4.3% and 1.5% respectively. **Exhibit 1** presents the global demand for acid copolymers and ionomers by region.

Exhibit 2 presents the global demand for acid copolymers and ionomers by type. Ionomers account for the 52% of the global demand while acid copolymers (EAA/EMAA) and specialty acid copolymers (EEA, EMA, & EnBA) account for 30% and 18% of the global demand respectively.

MAJOR OBJECTIVES

Assist polyolefin resin suppliers in expanding product portfolio, positioning and evaluating market and technology development programs

Assist end users in assessing the attractiveness of various end-use markets

Analyze the impact of metallocene-catalyzed plastomers/elastomers in Acid Copolymer and Ionomer end-use markets

Develop detailed attribute and value-based analysis for major Acid Copolymers and Ionomers end-use applications

KEY ISSUES ADDRESSED

In-depth analysis of the global Acid Copolymers and Ionomer markets

Patent Related Issue – Expiration of DuPont Patents on Acid Copolymers and Ionomers

Impact of metallocene-catalyzed plastomers on various end-use markets of Acid Copolymers and Ionomers

Current & future technologies for producing Acid Copolymers and Ionomers

Manufacturing cost analysis

Global market/technology positioning of major Acid Copolymer and Ionomer suppliers

The future of Acid Copolymers and Ionomers

End use requirements and unmet needs of major end-users

APPROACH

The information, data and conclusions of this analysis were developed from sources in North America, Europe and Asia, and were based upon, but not limited to, the following methods:

Interviews with industry experts, leading suppliers of Acid Copolymers and Ionomers, and major end-users in each market segment

A search, review and an interpretation of information from government sources, trade and industry groups, published articles and product promotional information

A thorough search of relevant patent technology and process details from producers

A review and update of information from non-proprietary CMR projects related to Acid Copolymers and Ionomers

A review and update of other multiclient studies completed by CMR

A review and update of the manufacturing cost economics based on our extensive cost databases and interviews

An analysis of the intermaterial competition based on "indifference analysis", a technique used by CMR and well accepted by our major clients.

TIMING, SUBSCRIPTION & ORDERING INFORMATION

This study was completed in August 2001 and is available for immediate delivery. The price of the study is U.S. \$8,000 for two copies of the report. Additional copies are available for \$500 each. To subscribe, simply sign the attached order form and mail or fax to CMR. This study is part of the Polyolefins M T & T series. For further information call us at 281-557-3320.

ABOUT OUR COMPANY

CHEMICAL MARKET RESOURCES, INC. was founded in 1990 to focus in the areas of marketing research and strategic planning. Our global clientele is concentrated within the chemical, petrochemical, plastics and related industries. Prior to joining CMR our associates held supervisory positions in chemical and allied industries. Our teams of professionals have strong technical backgrounds combined with hands-on business experience. Compilations of data, strategic analyses, writing and editing are entirely conducted in our state of the art facilities in-house to assure quality control at each stage of development. Our strength is in closely interacting with our clients to maximize effectiveness. We provide in-depth analyses with actionable statements in a cost-effective and timely fashion. Following are highlights of just some of our work in polyolefins.

Multiclient Studies

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Polyolefin Foams - North America, Europe and Japan 1996-2001 - Markets Technologies & Trends - Completed December 1996

High EVA Copolymers - North America, Europe and Japan 1996-2001 - Markets, Technologies & Trends - Completed June 1998

New generation Polyolefins vs. SB Copolymers - North America, Europe and Japan 1995 - 2000 - Markets, Technologies & Trends - Completed January 1995

Polypropylene Films - North America, Europe and Japan 1996-2001 - Markets Technologies & Trends - Completed December 1996

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Proprietary Studies

We have positioned numerous polyolefin products in the markets in North and Latin America, Europe, and Asia Pacific. We have conducted studies for most of the major polyolefin suppliers and end users - Call us for a list of proprietary studies.

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We conduct a highly successful Annual Conference FlexPO that covers intermaterial competition among flexible polymers including fPVC, polyolefins, TPES and rubbers. FlexPO 2001 will be held August 22nd through the 24th in the San Luis Hotel, Resort and Conference Center in Galveston (Houston), Texas.



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