

## DETERGENT ALKYLATES - WORLD MARKETS, 2006-2016

With nearly 3.7 million tons/year of global capacity, linear and branched alkylbenzenes are key surfactant intermediates. With the use of branched alkylbenzene declining rapidly since 2004, technical applications have become the main market for branched alkylbenzene sulfonates. Linear alkylbenzene consumption has benefitted from the decline of branched, as well as from a strong position relative to alcohol derivatives. With rising fats and oil prices disrupting the launch of nearly a million tons of new alcohol capacity due for start-up in 2007-2008, the competitive positioning of detergent alkylates has shifted favorably.

In the last three years, rapidly moving feedstock prices have challenged linear alkylbenzene (LAB) producers and customers. With feedstock prices appearing to moderate in 2007, LAB will be less vulnerable to competition from detergent alcohols. New alcohols capacity is competitive with LAB but alcohol derivatives face limited substitution potential in many markets. Competition from other surfactants, like alpha-olefin sulfonates, remains an issue and new capacity for methyl ester sulfonates represents a future challenge.

*Detergent Alkylates - World Markets, 2006-2016* includes a detailed global analysis of LAB, BAB and their sulfonated derivatives. The study reports on areas of potential substitution, consumption and trends, as well as competing materials. It evaluates historical, current and future (based on current announcements) supplies in each region for both LAB and BAB, and documents trade by country for 2006.

The study provides a full view of all facets of the detergent alkylate industry: raw material supplies and requirements, producers, surfactant consumption, environmental issues, and sulfonation capacities. It provides the outlook for LAB and BAB and their derivatives on a regional and global basis in the context of formulation issues, consumer preference, competition with other surfactants, demographic, environmental and customer-related issues.

This comprehensive study was completed in November 2007. The following pages contain the Table of Contents and other details.

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## DESCRIPTION OF THE STUDY

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*Detergent Alkylates - World Markets, 2006-2016* is a comprehensive study which details the production, capacity, trade and supply/demand balance by region for both linear and branched alkylbenzenes. Major factors affecting the outlook are examined including raw material requirements, surfactant consumption trends, novel technological developments, sulfonation capacity, and environmental issues, among others. Historical and forecast consumption of LABS and BABS are reviewed in depth for the 2000-2016 period by application and end use, incorporating an understanding of the formulation trends, competition with alcohol-based surfactants, consumer preferences and customer-oriented requirements.

A brief discussion of each of the main chapters is provided below.

### RAW MATERIALS

Regional capacities for normal paraffins, internal olefins, alpha-olefins, and propylene tetramer are detailed over the 2000-2006 period. Supply/demand issues are also addressed for each of these raw materials. The impact of the new Gas-to-Liquids plants, which offer a new source of normal paraffins, is reviewed. Feedstock requirements for LAB and BAB production over the 2000-2016 period are forecasted. Present and historical prices for these raw materials are also included to complete the picture.

### LAB AND BAB MARKETS

This section first reviews alkylbenzene technologies including processes, raw materials, reactor design and resulting LAB compositions. A discussion of the ongoing technological developments will emphasize novel processes, and potential new variants of LABS is also reviewed.

Regional market analyses includes an overview of current (2006), historical and future capacities with discussions of each producer. A historical 2003-2006 supply/demand balance is presented which includes demand and demand growth, production, and operating rates. A future 2006-2016 supply/demand balance details demand and demand growth in the context of current and future supply, and quantifies the expected surplus or shortage in LAB and BAB production capacities required to meet future regional demand.

A series of 2006 trade balances by region offer valuable insight about inter-regional movements of LAB and BAB along with individual country imports and sourcing. Pricing, consumption, market trends and demand-oriented issues are also

addressed. The European region includes new European Community (EC) member states in the East. East Europe includes Turkey, Russia and other former CIS countries not included in the EC.

## SURFACTANT END USE MARKET TRENDS AND ISSUES

This analysis of global and regional surfactant markets details total surfactant consumption by end use market area and discusses LABS, BABS and competing surfactants. Coverage of surfactants includes MES, AES, AS, AE and APE. Surfactant demand is forecast to 2016 by material to indicate how competition will develop between materials. Formulation issues, consumer preferences, and competition with other products such as alcohol-based surfactants are organized by major end use area: household, industrial and institutional cleaners, and industrial applications.

## ENVIRONMENTAL ISSUES

Environmental and health issues related to branched and linear alkylbenzene sulfonate as well as other surfactants are reviewed. Issues such as biodegradability, toxicity and environmental pollution are discussed and their potential impact on future regional consumption evaluated. Legislative efforts, testing methods and results are explained along with other prominent issues.

## LINEAR AND BRANCHED ALKYL BENZENE SULFONATE

This chapter begins with a discussion of sulfonation technology and tables of sulfonators and their capacities by country. LABS and BABS consumption is analyzed over the 2000-2016 period for each major region. Consumption of each sulfonated product is segmented by end use market (household, I&I, industrial), over the 2000-2016 period. Each regional analysis encompasses a discussion of end use markets and customers in which demographics, formulations, environmental issues and customer-related issues are evaluated.

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Central & West Europe				
Asia/Pacific				
East Europe				
Middle East/Africa				
TOTAL				
<b>BRANCHED ALKYL BENZENE</b>				
North America				
Latin America				
Central & West Europe				
Asia/Pacific				
East Europe				
Middle East/Africa				
TOTAL				

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Demand				
Capacity				
Surplus (Deficit)				
<b>LATIN AMERICA</b>				
Demand				
Capacity				
Surplus (Deficit)				
<b>CENTRAL &amp; WEST EUROPE</b>				
Demand				
Capacity				
Surplus (Deficit)				
<b>ASIA/PACIFIC</b>				
Demand				
Capacity				
Surplus (Deficit)				
<b>EAST EUROPE</b>				
Demand				
Capacity				
Surplus (Deficit)				
<b>MIDDLE EAST/AFRICA</b>				
Demand				
Capacity				
Surplus (Deficit)				
<b>WORLD</b>				
Demand				
Capacity				
Surplus (Deficit)				

Table 7						
WORLD - RAW MATERIAL CONSUMPTION FOR ALKYLATE PRODUCTION, 2000-2016 (thousand tons)						
Raw Material	2000	2006	2007	2010	2016	AAGR % 2006-2016
Normal paraffins						
Alpha-olefins						
Internal olefins						
Propylene tetramer						
TOTAL						

Table III-15					
NORTH AMERICA - ALKYL BENZENE SUPPLY/DEMAND, 2003-2006 (thousand tons)					
	2003	2004	2005	2006	AAGR % 2003-2006
LINEAR ALKYL BENZENE					
Demand					
Net Exports (Imports)					
Production					
Capacity					
Operating Rate (%)					
BRANCHED ALKYL BENZENE					
Demand					
Imports					
ALKYL BENZENE					
Demand					
Net Exports (Imports)					
Production					
Capacity					
Operating Rate (%)					

Table III-25

LATIN AMERICA - LAB TRADE BALANCE, 2006  
(thousand tons)

Producer	Capacity	Production	Imports		Exports		Consumption
			Country	Volume	Country	Volume	
ARGENTINA							
BRAZIL							
VENEZUELA							
COLOMBIA							
CHILE							

Table III-25 (Continued)							
Producer	Capacity	Production	Imports		Exports		Consumption
			Country	Volume	Country	Volume	
ECUADOR							
PERU							
URUGUAY							
Other Central America							
Caribbean Region							
Other South America							
TOTAL							

Table III-38						
ASIA/PACIFIC - ALKYL BENZENE SUPPLY/DEMAND, 2000-2016 (thousand tons)						
	2000	2006	2007	2010	2016	AAGR % 2006-2016
<b>LINEAR ALKYL BENZENE</b>						
Demand						
Capacity						
Surplus (Deficit) Capacity						
<b>BRANCHED ALKYL BENZENE</b>						
Demand						
Capacity						
Surplus (Deficit) Capacity						
<b>ALKYL BENZENE</b>						
Demand						
Capacity						
Surplus (Deficit) Capacity						

Table IV-17							
CENTRAL & WEST EUROPE - TOTAL PRIMARY SURFACTANT CONSUMPTION IN HOUSEHOLD APPLICATIONS, 2000-2016 (thousand tons)							
	2000	2006	2007	2010	2016	AAGR % 2000-2006	AAGR % 2006-2016
Linear alkylbenzene sulfonates							
Methyl ester sulfonates							
Alcohol ethoxylates							
Alcohol ethoxysulfates							
Alcohol sulfates							
Other <sup>a</sup>							
<b>TOTAL</b>							
<sup>a</sup> Does not include soap							

Table VI-18							
CENTRAL & WEST EUROPE - LINEAR ALKYL BENZENE SULFONATE CONSUMPTION IN MAJOR APPLICATIONS, 2000-2016 (thousand tons)							
	2000	2006	2007	2010	2016	AAGR % 2000-2006	AAGR % 2006-2016
Household							
I&I							
Industrial							
<b>TOTAL</b>							

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## QUALIFICATIONS AND PERSONNEL

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Colin A. Houston & Associates Inc. was founded in 1971 to provide consulting services to the chemical industry worldwide. The primary area of expertise was and continues to be surfactants: raw materials, intermediates, major surfactants, and the surfactant-consuming industries. Other areas of activity include: a variety of industry studies on such topics as detergent builders, ingredients for personal care products, and bleaching agents; engineering studies such as a worldwide study of glycerine evaporation plants with recommendations for improved efficiency; a world study of the state of the art in spray-drying detergents; contracts with the U.S. Government to develop industry effluent guidelines; and business strategy and acquisition studies.

The reputation thus earned by CAHA for comprehensive, high quality techno-economic and market analyses has led to a variety of engineering, marketing, and strategic planning studies for individual clients in North America, West Europe, Asia/Pacific and Other regions.

In 2007, CAHA completed its sixth global detergent alkylate study. Previous world detergent alkylate studies were conducted in 1988, 1990, 1992, 1995 and 2000. Since 2001, CAHA has published the LAB Market Report, six times per year and has kept readers informed on the detergent alkylate developments.

The project team approach utilized by CAHA includes a core of senior and technical professionals augmented by expert consultant associates. The following brief synopses present the staff and consultants who carried out the study, DETERGENT ALKYLATES - WORLD MARKETS, 2006-2016.

***Joel H. Houston, President,***

was the project leader for DETERGENT ALKYLATES - WORLD MARKETS, 2006-2016 and numerous other multiclient studies including HIGHER ALCOHOLS: MARKET FORECAST TO 2020, OPPORTUNITIES IN PERFORMANCE SURFACTANTS IN WEST EUROPE, SURFACTANTS FOR EMERGING MARKETS IN ASIA/PACIFIC, 1996-2010, SURFACTANTS FOR CONSUMER PRODUCTS - NORTH AMERICAN FORECAST TO 2008, and DETERGENT ALKYLATE - WORLD MARKETS, 1995-2010. He has guided CAHA's research in oleochemicals since 1980, and in detergents since 1987. Mr. Houston has extensive experience in projects for consumer products, has presented papers at CMRA, ECMRA and CSMA meetings, and is the editor of CAHA's global detergent newsletter, AGGLOMERATIONS, THE LAB MARKET REPORT and SURFACTANT DEVELOPMENTS NEWSLETTER. He is a member of CDMA, AOCS and ASTM.

***Marilyn L. Bradshaw, Vice President,***

authored sections of DETERGENT ALKYLATES - WORLD MARKETS, 2006-2016. She was the project leader for ALPHA-OLEFINS - WORLD MARKETS 2000-2010, INDUSTRIAL APPLICATIONS OF SURFACTANTS - NORTH AMERICAN FORECAST TO 2010 and POLYOLEFIN COMONOMERS - WORLD MARKETS, 1995-2005. Other multiclient studies she has directed include THE U.S. METALWORKING INDUSTRY AND SURFACTANT CONSUMPTION, 1995-2005, and U.S. I&I CLEANING PRODUCTS - SURFACTANT SUPPLIERS AND CUSTOMERS. She is the editor of CAHA's monthly alpha-olefin newsletter and provides consultation to clients on alpha-olefins. Since joining CAHA in 1980, she has also been the project leader for numerous proprietary projects such as an analysis of the growth prospects for 22 U.S. surfactant ethoxylators. Ms. Bradshaw has a B.A. from Finch College and an economics and management certificate from Manhattanville College.

***H. James Bigalow, Senior Research Associate,***

authored several sections of DETERGENT ALKYLATES - WORLD MARKETS, 2006-2016. In addition he has contributed to numerous multiclient studies including HIGHER ALCOHOLS - FORECAST TO 2020 and ALPHA-OLEFINS - WORLD MARKETS, 2000-2010, INDUSTRIAL APPLICATIONS OF SURFACTANTS - NORTH AMERICAN FORECAST TO 2010, SURFACTANTS FOR EMERGING MARKETS IN ASIA/PACIFIC, 1995-2010 and SURFACTANTS FOR CONSUMER PRODUCTS - NORTH AMERICAN FORECAST TO 2008. Mr. Bigalow has also worked on proprietary detergent and surfactant studies. Mr. Bigalow has over 20 years experience as a senior marketing research executive in the chemical industry. He has conducted successful business analysis projects which have included financial evaluations of businesses and acquisition candidates, identifying current and future markets for new and existing products, and product development and usage. Additional experience has included economic and sales forecasting, strategic planning, proprietary market research projects, benchmarking, and product safety. He is a member of the Society of Competitive Intelligence Professionals (SCIP), ACS and the Chemical Marketing and Economics Division of the ACS. Mr. Bigalow holds an M.S. Industrial Administration, Krannert School of Management, Purdue University and a B.S. degree in Chemistry, Denison University.

***John Rapko, Senior Research Associate***

authored section of DETERGENT ALKYLATES - WORLD MARKETS, 2006-2016, contributes to the LAB Market Report, authored the Higher Alcohols Technology section of HIGHER ALCOHOLS - FORECAST TO 2020 and has also assisted on numerous proprietary reports. In Dr. Rapko's 32 years of professional experience he has directed the work of professional chemists and chemical engineers at all degree levels in the areas of process development, chemistry, engineering and assessment of technologies related to the manufacture of detergent alkylate, detergent builders, zeolites, dehydrogenation catalysts, antimicrobials, amines, amino acids, chlorophenols, alkylphenols and alkylphenol ethoxylates, methyl ester sulfonates, phosphonates, bleaches and bleach ingredients, bleach activators, polymeric sequestrants and deflocculants, phosphorus chemicals, synthesis of <sup>14</sup>C labeled materials for environmental assessment, waste minimization and

remediation including incineration and processes for sulfuric acid recovery, construction and operation of bench scale evaluation and pilot units, project economics and start-up of commercial scale units. He holds a Ph.D. and B.S. in Chemistry (ACS Certified) from St. Louis University.

***Joseph Polak, Research Associate***

authored sections of DETERGENT ALKYLATES - WORLD MARKETS, 2006-2016 and authored portions of our bimonthly LAB Market Report. He also contributed to a proprietary study of the LAB markets in Asia and the Middle East. He holds a B.S. degree in Chemistry from Fordham University.

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## HOW TO SUBSCRIBE

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