Enzymes

US Industry Study with Forecasts to 2010 & 2015

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The best opportunities in the US enzyme market will be in proteases and carbohydrases, with the fastest growth occurring among smaller types -- such as phytase -- having strong, application-specific demand.

US demand to grow 6.9% annually through 2010

US demand for enzymes will grow 6.9 percent per year to $2.2 billion in 2010, bolstered by strong gains in important markets such as animal feed, biocatalysts, pharmaceuticals and starch processing. Other significant markets such as diagnostics, research and biotechnology, and food and beverages will also experience healthy growth, although a challenging environment in the cleaning products industry will limit advances. Volume annual gains will only be 2.7 percent as rapid increases in the high-value pharmaceutical and biocatalyst markets contribute to a shifting product mix and higher average prices.

Proteases, carbohydrases show best opportunities

Product growth will be broad-based with strong gains across all enzyme types. The best opportunities will be in proteases and carbohydrases, with the fastest growth occurring among smaller enzyme types -- such as phytase -- having strong, application-specific demand. Carbohydrases and proteases will continue to dominate demand because of their use in processing agricultural biomaterials, as well as rapid gains in several new carbohydrase- and protease-based pharmaceuticals. Polymerases and nucleases will benefit from both continued growth in biotechnology research, and the rapid development of new DNA- and RNA-based diagnostic tests for a variety of applications. Lipases will continue to find application in a number of areas, with gains in biocatalysts leading growth higher.

Pharmaceuticals, animal feed among fastest growing enzyme markets

Pharmaceuticals will remain the largest enzyme market, as well as one of the fastest growing, due principally to the rapid expansion of the orphan drug market for treating lysosomal storage disorders, as well as ongoing growth in neuromodulators, particularly for cosmetic procedures. Growth in the starch processing market will continue to accelerate as the rapid expansion of the ethanol industry overshadows and offsets weakness in sweetener production. The fastest growth will be recorded in animal feed additives as farmers seek ways to reduce phosphate run-off from animal waste. Double-digit gains will also occur in biocatalysts as enzymes increasingly find application in the synthesis of active pharmaceutical intermediates and other high value fine chemicals. An aging population will help drive near average gains in the diagnostic market, while ongoing research into biologically-derived pharmaceuticals and biocatalysts will support healthy advances in the research and biotechnology market. Food and beverage enzyme demand will also be healthy, supported by the development of new applications, and ongoing strength in dairy and bakery products.
Demand for carbohydrases is forecast to grow 6.5 percent per year to $800 million in 2010. Although advances will be strong, gains will be restrained by lackluster growth in the large high fructose corn syrup (HFCS) market due to saturation in soft drink applications, as well as growing consumer concern with high obesity rates, particularly among children. The best opportunities for growth exist in the fuel ethanol and pharmaceutical markets. The recent enactment of a national renewable fuel standard (RFS), along with the voluntary phase-out of MTBE (methyl tertiary-butyl ether) due to liability concerns, dramatically increased the demand for fuel ethanol, and consequently for the carbohydrases used to produce it. Pharmaceutical carbohydrases in the form of recombinant human glycosidases will witness very strong growth due to the introduction of new products, primarily targeted at the treatment of rare genetic disorders.

Besides rhglycosidases, carbohydrases include alpha amylase, glucoamylase, cellulase and hemicellulase, glucose isomerase, lactase, pectinase and other enzymes which break down carbohydrates such as cornstarch into simpler units. Carbohydrases are widely employed in wet corn milling operations, as well as in the food and beverage and detergent industries. Alpha amylase and glucoamylase will continue to account for the majority of carbohydrase sales through 2010 due to their widespread use in the production of corn sweeteners and ethanol, as well as other food and beverage products. While strong competition and the commodity status of high volume detergent and starch conversion enzymes will hold down prices, thereby restraining growth in carbohydrase demand, this effect will be offset by rapid expansion of the fuel ethanol market and the rapid gains for several new high-value carbohydrase-based drugs.

Recombinant human glycosidases are forecast to record the fastest growth, spurred by the development of several new drugs for treating a

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**TABLE V-1**

**ENZYME DEMAND BY PRODUCT**

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>Nondurable Goods Shipments (bil $)</td>
<td>1511</td>
<td>1743</td>
<td>2072</td>
<td>2315</td>
<td>2615</td>
</tr>
<tr>
<td>$ enzyme/000$ nondurables</td>
<td>0.62</td>
<td>0.68</td>
<td>0.77</td>
<td>0.97</td>
<td>1.15</td>
</tr>
<tr>
<td>Enzyme Demand</td>
<td>930</td>
<td>1190</td>
<td>1605</td>
<td>2240</td>
<td>3020</td>
</tr>
<tr>
<td>Carbohydrases</td>
<td>371</td>
<td>440</td>
<td>585</td>
<td>800</td>
<td>1015</td>
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<tr>
<td>Proteases</td>
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<td>345</td>
<td>460</td>
<td>653</td>
<td>915</td>
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<tr>
<td>Polymerases</td>
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<td>116</td>
<td>145</td>
<td>195</td>
<td>265</td>
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<tr>
<td>Nucleases</td>
<td>62</td>
<td>95</td>
<td>123</td>
<td>163</td>
<td>212</td>
</tr>
<tr>
<td>Lipases</td>
<td>48</td>
<td>67</td>
<td>88</td>
<td>117</td>
<td>155</td>
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<tr>
<td>Other</td>
<td>86</td>
<td>127</td>
<td>204</td>
<td>312</td>
<td>458</td>
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<tr>
<td>$/lb</td>
<td>4.89</td>
<td>5.41</td>
<td>6.42</td>
<td>7.86</td>
<td>9.29</td>
</tr>
<tr>
<td>Enzyme Demand (mil lb)</td>
<td>190</td>
<td>220</td>
<td>250</td>
<td>285</td>
<td>325</td>
</tr>
</tbody>
</table>

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**CHART VI-1**

**US ENZYME MARKET SHARE, 2005**

($1.6 billion)

- Market Leaders: 55.6%
- Others: 44.4%
Axcan Pharma Incorporated
597 Laurier Boulevard
Mont-St-Hilaire, Quebec J3H 6C4
Canada
450-467-5138
http://www.axcan.com

Revenues: US$251 million (FY 2005)
Employment: 440 (FY 2005)

Key Products: enzyme-replacement therapeutics

Axcan Pharma is a specialty pharmaceutical company concentrating on the field of gastroenterology. The Company develops, manufactures and markets a broad range of pharmaceutical products and services used for treating gastrointestinal diseases and related disorders.

The Company is involved in the enzyme industry through the production of prescription enzyme supplements used to treat certain gastrointestinal symptoms. In particular, Axcan’s products for the US market include ULTRASE and VIOKASE enzyme-replacement therapeutics, both of which are used for the treatment of partial or complete exocrine pancreatic insufficiency. In these application, ULTRASE and VIOKASE pancrelipase pharmaceuticals serve to replace or supplement a patient’s natural digestive enzymes when disease or surgery prevents their normal flow. In this manner, ULTRASE and VIOKASE products aid in the digestion and absorption of foods, including fat, carbohydrates and proteins. Related products made by the Company include PANZYTRAT enzyme-replacement therapeutics, which are marketed in several countries in Europe for the treatment of pancreatic insufficiency.

“Demand for dairy enzymes is projected to advance 3.6 percent per year to $62 million in 2010, boosted by continued strong growth in enzymes such as lactase due to the aging of the US population. In contrast, slow overall growth in cheese production volume will limit faster advances, though specialty enzymes that facilitate faster cheese production will continue to benefit.”

--Section IV, pg. 100
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World Enzymes
World demand for enzymes will grow 7.6% annually through 2011. Gains will be driven by continued robust growth in pharmaceutical enzyme demand, double-digit increases in demand for biocatalysts for drug and fine chemical production, and the rapid expansion in bioethanol production from grains. This study analyzes the $2.7 billion US biocompatible industry and for 2010 and 2015 by material and application. It also analyzes the most valuable market while argon will be the fastest growing gas. This study analyzes the $8.4 billion world lubricant industry, with forecasts for 2010 and 2015 by formulation, product, market, region and for 31 countries. It also evaluates the status quo and focuses major players.

Specialty Gases
Specialty gas demand in the US will grow 5% annually through 2011. Best market opportunities are expected in electronics and manufacturing, as well as in a variety of new and/or lower volume uses such as home health care, propellants and packaging. Oxygen, noble gases and fluorine-based gases will lead gains by type. This study analyzes the $2.8 billion US specialty gas industry, with forecasts for 2011 and 2016 presented by product and market. It also evaluates market share and profiles major players.

World Lubricants
Global demand for lubricants will reach 41.8 million metric tons in 2010. Gains will be driven by increasing motor vehicle ownership and use and growth in manufacturing activity. Engine oils will continue to claim over half of demand, while process oils will grow the fastest. Manufacturing markets will lead gains. This study analyzes the $35.7 billion world lubricant industry, with forecasts for 2010 and 2015 by formulation, product, world region and for 31 countries. It also evaluates market share and profiles major players.

Industrial Gases
US industrial gas demand will grow 3.6% annually through 2010. Best opportunities will remain in the key petroleum and natural gas market while faster growth will occur in smaller volume uses such as electronics and healthcare. Hydrogen will continue as the most valuable market while argon will be the fastest growing gas. This study analyzes the $8.4 billion US industrial gas industry for 2010 and 2015 by type, delivery method and market. It also details company market share and profiles major players.

Biocompatible Materials
US demand for biocompatible materials will grow 6.6% yearly through 2010. Synthetic polymers will remain dominant based on quality, performance and cost advantages in most applications. Ceramics will grow the fastest, driven by improved properties and processing ease. Hyaluronic acid and collagen will pace the natural polymer segment. This study analyzes the $2.7 billion US biocompatible industry for 2010 and 2015 by material and application. It also evaluates market share and profiles major players.

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