EXPLOSIVES

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In 2004, U.S. explosives production was 2.52 million metric tons (Mt), a 10% increase from that in 2003; sales of explosives were reported in all States. Coal mining, with 67% of total consumption, continued to be the dominant use for explosives in the United States. Wyoming, West Virginia, and Kentucky, in descending order, led the Nation in coal production, accounting for 59% of the total. These States also were the leading explosives-consuming States.

Production

Sales of ammonium-nitrate-base explosives (blasting agents and oxidizers) were 2.48 Mt, which was a 10% increase from those of 2003, and accounted for 98% of U.S. industrial explosives sales. Sales of permissibles decreased by 9%, and sales of other high explosives increased by 17% (table 1). Figure 1 shows how sales for consumption have changed since 1995.

Companies contributing data to this report, including those that are not members of the Institute of Makers of Explosives (IME), are as follows:

Accurate Energetic Systems LLC
Apache Nitrogen Products Inc.*[1]
Austin Powder Co.
Baker Atlas International
Daveyfire Inc.
D.C. Guelich Explosives Co.
Douglas Explosives Inc.
Dyno Nobel Inc.
Ensign-Bickford Co., The
General Dynamics Armament Systems
Jet Research Center
Mining Services International Corp.
Nelson Brothers LLC*
Nitrochem LLC
Orica USA Inc.
Owen Oil Tools Inc.
St. Lawrence Explosives Corp.
Schlumberger Perforating Center
SEC LLC
Senex Explosives Inc.
Vet's Explosives Inc.
Viking Explosives and Supply Co.
W.A. Murphy Inc.

In July, Dyno Nobel Inc. (a subsidiary of Dyno Nobel ASA) sold its 50% ownership in Geneva Nitrogen LLC to Austin Nitrogen LLC (a unit of Austin Powder Co.). The sale was required of Dyno Nobel by the U.S. Department of Justice (DOJ) as a condition of its purchase of the nitrogen assets of El Paso Corp. in 2003. The DOJ was concerned that explosives-grade ammonium nitrate customers in the Western United States would face higher prices unless Dyno Nobel sold some of its assets. The Geneva Nitrogen plant, which was owned by Dyno Nobel before its purchase of El Paso, had the capacity to produce 100,000 metric tons per year (t/yr) of explosives-grade ammonium nitrate (Green Markets, 2004b).

Consumption

Coal mining, with 67% of total explosives consumption, remained the leading application for explosives in the United States (table 2). In 2004, U.S. coal production increased by 3.7% to 1.01 Mt, according to preliminary data from the U.S. Department of Energy, Energy Information Administration (EIA). Coal production in the Appalachian and western regions increased in 2004 and was essentially the same in the interior region. The increase in coal production in the Appalachian region accounted for about one-third of the total increase in U.S. coal production (Freme, 2005§[2]). Wyoming, West Virginia, and Kentucky, in descending order, led the Nation in coal production, accounting for 59% of the total. These States also were the leading explosives-consuming States.

Quarrying and nonmetal mining, the second ranked consuming industry, accounted for 13% of total explosives sales; construction, 9%; metal mining, 8%; and miscellaneous uses, 3%. Wyoming, West Virginia, Kentucky, Indiana, Virginia, and Pennsylvania, in descending order, were the leading consuming States, with a combined total of 58% of U.S. sales (table 3).

According to U.S. Census Bureau statistics, the value of new construction in 2004 increased by 11.1% compared with that in 2003 (U.S. Census Bureau, 2005§). Based on monthly data from the Federal Reserve Board, the seasonally adjusted industry growth rate from 2003 to 2004 for metal mining was 0.5%, and the growth rate for nonmetallic mineral mining and quarrying was 1.0% (Federal Reserve Board, 2005§).

Classification of Industrial Explosives and Blasting Agents.—Apparent consumption of commercial explosives used for industrial purposes in this report is defined as sales as reported to the IME. Commercial explosives imported for industrial uses were included in sales.

The principal distinction between high explosives and blasting agents is their sensitivity to initiation. High explosives are cap sensitive, whereas blasting agents are not. Black powder sales were minor and were last reported in 1971. The production classifications used in this report are those adopted by the IME.

[1]Companies denoted by an asterisk are not members of the IME.

[2]References that include a section mark (§) are found in the Internet References Cited section.

High Explosives.—Permissibles.—The Mine Safety and Health Administration approved grades by brand name as established by National Institute of Occupational Safety and Health testing.

Other High Explosives.—These include all high explosives except permissibles.

Blasting Agents and Oxidizers.—These include ammonium nitrate-fuel oil (ANFO) mixtures, regardless of density; slurries, water gels, or emulsions; ANFO blends containing slurries, water gels, or emulsions; and ammonium nitrate in prilled, grained, or liquor (water solution) form. Bulk and packaged forms of these materials are contained in this category. In 2004, about 92% of the total blasting agents and oxidizers was in bulk form.

World Review

Africa.—African Explosives (Ghana) Ltd. was awarded a 4-year contact to supply the explosives requirements of Goldfields Ghana Ltd.'s Tarkwa Mine. The contract was valued at more than $30 million for the 4-year period (African Explosives Ltd., 2004a§). The parent company, African Explosives Ltd. (AEL), was awarded a contract to supply explosives to Barrick Gold Corp.'s Tulawaka Mine that was opening in western Tanzania in 2005 (African Explosives Ltd., 2004b§). In Tanzania, AEL's $1.3 million modular bulk emulsion manufacturing facility at Geita doubled its output from 2003 to meet the sharply rising demand for bulk explosives. The Geita Gold Mine, for which AEL's plant was initially established, has been increasing its bulk explosive requirements as it expands operations with new satellite pits (African Explosives Ltd., 2004c§). AEL operated in 14 countries, and had explosive manufacturing plants in Botswana, Ethiopia, Ghana, Mali, South Africa, Tanzania, and Zambia.

In March, Sasol International and Orica Ltd. agreed that Orica would acquire the electronic detonator technology of Sasol Mining Initiators (Pty) Ltd. Using this technology, Sasol will manufacture electronic detonators for Orica for distribution primarily into the African market (Orica Ltd., 2004a§).

Australia.—In August, Orica completed an expansion of 110,000 t/yr at its Kooragang Island, New South Wales, ammonium nitrate facility, which was designed to supply increases in demand in Australia and southeast Asia. The company announced that it was considering expanding production capacity at its ammonium nitrate plant in Yarwun, Queensland, by approximately 300,000 t/yr in 2006. This expansion is in addition to the 25,000-t/yr expansion scheduled for completion in March 2005. After the 300,000-t/yr expansion, total ammonium nitrate production capacity at Yarwun would be 595,000 t/yr. The planned expansion was in response to increased demand for explosives at Queensland metallurgical-coal-producing mines (Orica Ltd., 2004b§).

Brazil.—In March, Dyno Nobel signed an agreement to acquire Magnum S.A., the second ranked explosives company in Brazil, from the J. Mendes group. The new company, which will be called Dyno Nobel Magnum, averaged gross annual sales of $14 million. Magnum's main explosives production facility in Itauna, Minas Gerais, near Belo Horizonte supplied explosives to the country's construction, energy, mining and quarrying industries (Dyno Nobel ASA, 2004§).

Current Research and Technology

Specialty Fertilizer Products LLC, based in Belton, MO, filed for U.S. and international patents for a water-soluble polymer coating for ammonium nitrate fertilizer granules that repels fuel oil. The coating forms a thin film that dissolves rapidly in soil, so it would not interfere with ammonium nitrate's main function as a fertilizer. This coating could make fertilizer-grade ammonium nitrate more difficult to use as an explosive (Green Markets, 2004a).

Researchers at the Danish company Aresa Biodetection ApS produced a genetically modified plant that may help detect hidden landmines by changing its color from green to red when its roots come in contact with explosives. The discovery is based on genetic engineering of the plant thale cress, scientifically known as Arabidopsis thaliana. The genetically modified plant changes its color from green to red within 3 to 5 weeks of growth when its roots come in contact with nitrogen dioxide, a chemical group present in explosives. Another potential application would be the detection and removal of heavy metals in polluted soil. Initial testing of the plant's ability to detect unexploded landmines was scheduled to take place in Bosnia and Herzegovina, Sri Lanka, and parts of Africa (ABC News online, 2004§).

The Defense Advanced Research Projects Agency awarded Spire Corp. a $750,000 Phase II Small Business Innovation Research Program contract to develop a terahertz radiation system. The small and portable system, which will contain Spire's quantum cascade lasers, could enable detection of hidden explosives. Because it can penetrate most container materials, terahertz radiation is well suited to detecting hidden weapons and explosives. Spire will collaborate with the University of Illinois at Urbana-Champaign on the design of the quantum cascade lasers (Compound Semiconductor.net, 2004§).

System Planning Corp. began testing "smart containers" for freight shipments to the United States. Smart containers are equipped with sensors attached to their interiors by magnets or tape. The sensors in the System Planning test will detect chemical, biological, and nuclear material. The sensors then will relay data through wireless technology to handheld and fixed readers and via satellite to a command and control center. The smart containers will be tracked along maritime trade routes to the Port of Tacoma, WA, and to the Port of New York, NY, and New Jersey as part of the test. Some of the smart containers will also be driven by tractor-trailer from New York and New Jersey to a tiny island in Maine that is being made a test bed for homeland security technologies. The containers will be under constant surveillance on sea and land (Baard, 2004§).

Scientists at Texas Tech University made a nanocomposite of aluminum and iron oxide (Fe_2O_3) that reacts exothermically when ignited. The material could have applications in explosives or as an energy source in micro-electro-mechanical systems devices or in space. The researchers made a honeycomb-like alumina template by electrochemical anodization of an aluminum foil in an acid. They were able

to tailor the diameter of the template's pores by altering the voltage and the acid used, producing pores between 10 and 150 nanometers (nm). The team then electrodeposited iron inside the template pores, which they later oxidized to make Fe_2O_3 nanowires. After various additional steps, the researchers added a 50-nm layer of aluminum on top of the nanowires, forming a structure in which the nanowires were partially embedded in the aluminum layer. Igniting samples of the nanocomposite caused them to burn with a flame temperature of around 4,000° C. The scientists estimated that the energy released was about 1,000 times greater than the amount released by a purely surface reaction. The researchers planned to study the reaction mechanism, thermodynamics, and kinetics of the ignition process (Kalaugher, 2004§).

Outlook

According to the EIA, coal demand in the electric power sector was expected to increase by 2.9% in 2005 and 1.5% in 2006. Power sector demand for coal was projected to increase because oil and natural gas prices were projected to remain at high levels. U.S. coal production was expected to grow in 2005 and 2006 by the same percentages as coal demand for electricity (U.S. Department of Energy, Energy Information Administration, 2005§). Based on the coal production projections, explosives consumption is expected to increase in 2005 and 2006.

Growing concerns about security have led to decisions by several U.S. producers of agricultural-grade ammonium nitrate to stop production in 2005. In addition, members of the U.S. Congress have introduced two bills (H.R. 3197 and S. 1141) that would promulgate regulations requiring registration of all facilities that handle ammonium nitrate fertilizer and recordkeeping on all purchases of ammonium nitrate fertilizer (Fertilizer Institute, The, 2005§). Similar security concerns and the potential legislation eventually may affect the production of ammonium nitrate-base explosives in the United States.

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TABLE 1
SALIENT STATISTICS OF INDUSTRIAL EXPLOSIVES AND BLASTING AGENTS SOLD FOR CONSUMPTION IN THE UNITED STATES[1]

(Metric tons)

Class	2003	2004
Permissibles	1,070	970
Other high explosives	35,500	41,700
Blasting agents and oxidizers	2,250,000	2,480,000
Total	2,290,000	2,520,000

[1]Data are rounded to no more than three significant digits; may not add to totals shown.

Source: Institute of Makers of Explosives.

TABLE 2
ESTIMATED INDUSTRIAL EXPLOSIVES AND BLASTING AGENTS SOLD FOR CONSUMPTION IN THE UNITED STATES, BY CLASS AND USE[1, 2]

(Thousand metric tons)

Class	Coal mining	Quarrying and nonmetal mining	Metal mining	Construction work	All other purposes	Total
2003:						
Permissibles	1	(3)	(3)	(3)	--	1
Other high explosives	5	16 r	1	12	2 r	36
Blasting agents and oxidizers	1,550 r	307 r	163 r	168 r	64 r	2,250
Total	1,560 r	323 r	164 r	180 r	66 r	2,290
2004:						
Permissibles	1	(3)	(3)	(3)	--	1
Other high explosives	5	17	1	16	3	42
Blasting agents and oxidizers	1,690	319	185	216	64	2,480
Total	1,700	336	186	232	67	2,520

rRevised. -- Zero.

[1]Distribution of industrial explosives and blasting agents by consuming industry estimated from indices of industrial production and economies as reported by the U.S. Department of Energy, the Federal Reserve Board, the U.S. Department of Transportation, and the U.S. Census Bureau.

[2]Data are rounded to no more than three significant digits; may not add to totals shown.

[3]Less than ½ unit.

TABLE 3
INDUSTRIAL EXPLOSIVES AND BLASTING AGENTS SOLD FOR CONSUMPTION IN THE UNITED STATES, BY STATE AND CLASS[1]

(Metric tons)

	2003				2004			
	Fixed high explosives				Fixed high explosives			
State	Permissibles	Other high explosives	Blasting agents and oxidizers	Total	Permissibles	Other high explosives	Blasting agents and oxidizers	Total
Alabama	29	663	61,100	61,700	21	582	65,400	66,000
Alaska	--	29	10,500	10,500	--	541	17,500	18,000
Arizona	40	508	66,100	66,600	39	412	58,700	59,200
Arkansas	(2)	164	9,930	10,100	--	256	22,900	23,200
California	2	765	41,500	42,300	--	724	26,900	27,700
Colorado	51	4,010	64,600	68,600	88	1,530	22,800	24,400
Connecticut	--	384	4,720	5,100	--	420	5,490	5,910
Delaware	--	1	63	64	--	105	432	538
Florida	--	202	17,000	17,200	--	263	32,900	33,100
Georgia	1	1,160	37,300	38,500	22	1,200	46,500	47,700
Hawaii	--	19	834	853	--	15	1,330	1,350
Idaho	(2)	111	12,600	12,700	--	175	7,980	8,160
Illinois	1	618	38,000	38,600	--	837	49,400	50,200
Indiana	38	1,070	204,000	205,000	(2)	1,440	197,000	199,000
Iowa	1	987	14,400	15,400	--	1,250	16,100	17,300
Kansas	1	723	11,100	11,900	--	447	13,300	13,700
Kentucky	439	1,410	264,000	266,000	549	2,220	327,000	330,000
Louisiana	--	639	2,230	2,870	--	467	3,870	4,340
Maine	--	17	1,460	1,480	--	104	2,910	3,020
Maryland[3]	3	122	8,030	8,160	3	325	13,800	14,100
Massachusetts	--	500	4,660	5,160	4	532	7,820	8,360
Michigan	--	71	20,400	20,400	--	111	26,800	26,900
Minnesota	--	159	51,000	51,200	--	112	35,100	35,200
Mississippi	--	12	64	75	--	458	64	522

See footnotes at end of table.

TABLE 3—Continued

INDUSTRIAL EXPLOSIVES AND BLASTING AGENTS SOLD FOR CONSUMPTION IN THE UNITED STATES, BY STATE AND CLASS[1]

(Metric tons)

State	2003				2004			
	Fixed high explosives				Fixed high explosives			
	Permissibles	Other high explosives	Blasting agents and oxidizers	Total	Permissibles	Other high explosives	Blasting agents and oxidizers	Total
Missouri	3	1,460	61,000	62,400	--	3,340	60,500	63,800
Montana	(2)	578	27,200	27,800	--	2,280	53,900	56,200
Nebraska	--	397	1,510	1,900	--	240	929	1,170
Nevada	1	2,400	41,000	43,400	--	2,800	39,800	42,600
New Hampshire	--	672	10,800	11,500	--	635	11,400	12,000
New Jersey	1	240	23,100	23,300	1	396	5,890	6,280
New Mexico	--	95	4,230	4,320	--	279	25,100	25,400
New York	(2)	478	14,300	14,800	12	682	15,800	16,500
North Carolina	15	814	29,900	30,700	--	921	32,900	33,800
North Dakota	--	4	1,910	1,910	--	2	3,700	3,710
Ohio	3	1,010	49,300	50,300	1	818	58,100	58,900
Oklahoma	2	447	16,800	17,300	(2)	356	28,300	28,700
Oregon	--	184	4,990	5,180	--	1,430	7,280	8,710
Pennsylvania	71	1,490	127,000	128,000	77	2,950	101,000	104,000
Rhode Island	--	98	1,340	1,430	(2)	50	1,190	1,240
South Carolina	1	139	4,960	5,100	--	221	5,830	6,050
South Dakota	--	3	4,490	4,500	--	3	4,290	4,300
Tennessee	68	1,120	30,300	31,500	1	1,740	33,600	35,300
Texas	18	457	40,200	40,700	19	1,080	83,300	84,400
Utah	37	555	81,300	81,900	44	337	43,000	43,400
Vermont	7	164	378	549	(2)	153	1,150	1,300
Virginia	106	3,300	141,000	145,000	15	3,630	126,000	130,000
Washington	(2)	1,030	14,800	15,800	--	772	20,300	21,100
West Virginia	121	719	331,000	332,000	73	667	347,000	348,000
Wisconsin	6	888	11,800	12,600	--	807	14,000	14,800
Wyoming	--	2,420	231,000	234,000	--	559	350,000	351,000
Total	1,070	35,500	2,250,000	2,290,000	970	41,700	2,480,000	2,520,000

-- Zero.

[1]Data are rounded to no more than three significant digits; may not add to totals shown.

[2]Less than ½ unit.

[3]Includes the District of Columbia.

Source: Institute of Makers of Explosives.

FIGURE 1
SALES FOR CONSUMPTION OF U.S. INDUSTRIAL EXPLOSIVES