EXPLOSIVES

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In 2003, U.S. explosives production was 2.29 million metric tons (Mt), 9% lower than that in 2002; 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 largest explosives-consuming States.

Production

Sales of ammonium-nitrate-base explosives (blasting agents and oxidizers) were 2.29 Mt, which was a 9% decrease from those of 2002, and accounted for 98% of U.S. industrial explosives sales. Sales of permissibles declined by 21%, and sales of other high explosives decreased by 7% (table 1). Figure 1 shows how sales for consumption have changed since 1994.

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.
Douglas Explosives Inc.
Dyno Nobel Inc.
Ensign-Bickford Co., The
D.C. Guelich Explosives Co.
General Dynamics Armament Systems
Jet Research Center
Mining Services International Corp.
Nelson Brothers LLC*
Nitrochem LLC
Orica USA Inc.
Owen Oil Tools Inc.
Schlumberger Perforating Center
SEC LLC
Senex Explosives Inc.
Titan Completion Products Ltd.
Vet's Explosives Inc.
Viking Explosives and Supply Co.
W.A. Murphy Inc.

In December, Dyno Nobel ASA acquired the ammonia-ammonium nitrate assets of El Paso Corp. for about $57 million. The acquisition included ammonia-manufacturing capacity of 275,000 metric tons per year (t/yr) at Cheyenne, WY, and St. Helens, OR, and ammonium nitrate production capacity of 318,000 t/yr of low-density ammonium nitrate prill and 91,000 t/yr of ammonium nitrate solution at Cheyenne and Battle Mountain, NV (Green Markets, 2003b). El Paso had acquired the nitrogen plants in a 2001 merger with Coastal Corp.

In June, Dyno Nobel purchased a majority ownership share in St. Lawrence Explosives Corp. (SLE), which included its wholly owned subsidiary Hall Explosives Inc. and its interest in SLE Canada (Dyno Nobel ASA, 2003d§[2]).

Nitram Inc. closed its Tampa, FL, plant in August after filing for bankruptcy protection earlier in the year. The company was considering the sale of the plant, which has the capacity to produce 281,000 t/yr of ammonium nitrate (agricultural and industrial grade) and 204,000 t/yr of nitric acid (Green Markets, 2003c). In a November bankruptcy auction, LSB Industries Inc. acquired Nitram's equipment for $1.3 million, and Kinder Morgan Inc. acquired the real estate for $1.6 million (Green Markets, 2003a).

[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.

Consumption

Coal mining, with 67% of total explosives consumption, remained the largest application for explosives in the United States (table 2). In 2003, U.S. coal production declined by 2.3% to 970 Mt, according to preliminary data from the U.S. Department of Energy, Energy Information Administration (EIA). For the first time since 2000, production in all three coal-producing regions declined, with a slight drop in production in the interior and western regions, while the large decline in Appalachia accounted for more than 85% of the total decrease. The major issues that had an effect on coal production in 2003 were primarily legal and financial but also included operational problems (Freme, 2004§). 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 largest explosives-consuming States.

Quarrying and nonmetal mining, the second-largest consuming industry, accounted for 14% of total explosives sales; construction, 8%; metal mining, 8%; and miscellaneous uses, 3%. West Virginia, Kentucky, Wyoming, Indiana, Virginia, and Pennsylvania, in descending order, were the leading consuming States, with a combined total of 57% of U.S. sales (table 3).

According to U.S. Census Bureau statistics, the value of new construction in 2003 increased by 2.8% compared with that in 2002 (U.S. Census Bureau, 2004§). Based on monthly data from the Federal Reserve Board, the seasonally adjusted industry growth rate from 2002 to 2003 for metal mining was -3.8%, and the growth rate for nonmetallic mineral mining and quarrying was -0.1% (Federal Reserve Board, 2004§).

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.

High Explosives.—*Permissibles.*—The Mine Safety and Health Administration approved grades by brand name as established by the 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 2003, about 94% of the total blasting agents and oxidizers was in bulk form.

World Review

Australia.—Orica Ltd. announced that it would expand the production capacity of its ammonium nitrate plant in Yarwun, Queensland, by about 25,000 t/yr. The cost of this upgrade was estimated to be A$13.5 million and was expected to be completed by March 2005. The capacity increase was in response to increased demand for ammonium nitrate on the Australian east coast. The expansion followed a 15% increase in the plant capacity to 275,000 t/yr that was completed in April 2003. Work also was underway to increase production by 40% at Orica's Kooragang Island, New South Wales, ammonium nitrate plant. This expansion was expected to cost A$50 million and to be completed by the end of 2004 (Industry Search, 2004§).

In April, Orica increased its ownership of Initiating Explosive Systems Pty. Ltd. (IES) to 100% following the purchase of Ensign Bickford's 30% share for A$16 million. IES manufactured initiating explosives systems, such as detonators, detonating cord, and boosters, which were sold to Orica Mining Services for use with explosives in mining and quarrying (Orica Ltd., 2003§).

In December, Dyno Nobel entered into a share-purchase agreement, increasing its ownership in Queensland Nitrates Pty. Ltd. to 50% from 25%. Queensland Nitrates operated an ammonium nitrate plant at Moura, Queensland, with the capacity to produce about 180,000 t/yr of explosive-grade ammonium nitrate in the form of low-density prill and solution. Dyno Nobel used the ammonium nitrate in its adjacent emulsion plant. Following the purchase, Dyno Nobel planned to expand the Qeensland Nitrates plant, although no capacity figures were announced (Dyno Nobel ASA, 2003c§).

Peru.—Dyno Nobel and Enaex S.A. signed an agreement to merge their respective subsidiaries Dyno Nobel del Peru and Samex into one company in Peru. Enaex produced low-density ammonium nitrate and had a total capacity of 450,000 t/yr. Enaex also manufactured high explosives and blasting agents. The new company will be named Dyno Nobel-Samex (Dyno Nobel ASA, 2003b§).

South Africa.—African Explosives Ltd. (AEL) (a subsidiary of AECI Ltd.), which was a supplier of commercial explosives and initiation systems in Africa, formed a 50-50 joint-venture company with Dyno Nobel called DetNet International. DetNet International will acquire all the existing electronic detonator systems, technologies, and associated assets of both companies. All future design, promotion, and support of electronic detonator systems will be the responsibility of DetNet International. The assembly, marketing, and sales of the products will be implemented primarily through Dyno Nobel and AEL. Dyno Nobel will contribute the initial $7 million of the joint venture's cash requirements, an amount that represents the difference between the value of the business and assets that the two companies are contributing to the joint venture (Dyno Nobel ASA, 2003a§).

Current Research and Technology

Researchers at the University of Missouri-Rolla developed glass microspheres—each about the width of a human hair—to trace explosives back to their manufacturers. The glass microsphere's chemical composition becomes a signature and can provide the name of company, the plant location, and the day it was manufactured. By controlling the chemical composition, this information can be included inside the glass microsphere and only the manufacturer of the explosive has the code. According to the researchers, glass microspheres are already added to explosives to improve performance and have not caused a safety problem. The glass spheres already added to explosives are hollow, whereas the microspheres would be solid. After an explosive detonates, the solid glass microspheres would be found in and around the explosion site. The microspheres then can be detected using a variety of methods depending on what was added to the spheres when they were formed (University of Missouri-Rolla, 2003§).

A research team from Oak Ridge National Laboratories and the University of Tennessee developed a small, inexpensive sensor that can detect minute quantities of plastic explosives in the air. The device is a v-shaped silicon cantilever, 180 micrometers (µm) long by 25 µm wide. Such microcantilevers as this already are used to detect minute quantities of biological molecules such as DNA and proteins. The researchers adapted the technology to detect two chemicals typically found in plastic explosives—pentaerythritol tetranitrate (PETN) and hexahydro-1,3,5-triazine (RDX). The team first coated the upper surface of a cantilever with a layer of gold, and then added a one-atom-thick layer of an acid that normally binds to both PETN and RDX. When a stream of air containing trace amounts of the explosives passed over the cantilever, molecules of PETN and RDX attached to the cantilever's coated surface, causing the cantilever to bend. A laser pointing at the tip of the cantilever detected the degree of bending; the more explosives present, the greater the curvature. In recent experiments, the sensor could detect 14 parts per trillion (ppt) of PETN in 20 seconds and about 30 ppt of RDX in 25 seconds. The sensor, with its high speed and sensitivity could be used at airport-security checkpoints, border crossings, and ports. Because each silicon cantilever costs about a dollar and the entire device is the size of a shoebox, deploying the technology could be relatively easy (Goho, 2003).

Researchers at University of California, Berkeley made about 1 trillion silver nanowires and packed them tightly together in a thin layer, all pointing in the same direction. The layer of ordered nanowires made an ideal site for chemicals to bind for detection by surface-enhanced Raman spectroscopy. According to the researchers, the monolayer of silver nanowires makes a very sensitive substrate on which to detect molecules like dinitrotoluene (DNT), which is used in making essentially all explosives, including landmines. Landmines would emit DNT vapor, which would allow airborne detection. The packed silver nanowires are a better surface for enhanced Raman spectroscopy than a thin layer of silver because the nanowire surface is more ordered and gives a more clearly defined signal, making interpretation of the Raman vibrational spectrum easier. In addition, the packed silver nanowires are uniform, reproducible, and suitable for use in air or in liquid. The researchers hope to miniaturize the laser and other components required by Raman spectroscopy to create a microscopic sensor on a chip, allowing very sensitive and specific detection of chemicals like explosives (Sanders, 2003§).

Scientists at the National Institute of Standards and Technology and SPARTA Inc., Rosslyn, VA, developed a new technique that uses far-infrared radiation to identify bulk or airborne materials inside sealed paper or plastic containers. The method involves directing a far-infrared light source at a sample in a closed container, detecting the light transmitted through the materials, and then analyzing the light that was absorbed by the sample while making adjustments for the light absorbed by the container. The pattern of light frequencies or spectra absorbed by a material is specific to the material's atoms and its crystalline structure. This method can identify compounds made of molecules containing three to hundreds of atoms, which is the size of many threat materials. The technology has potential applications such as detection of explosives in the mail or other nonmetallic portable containers (Science Daily, 2003§).

Outlook

The EIA projected a 2.3% increase in coal production in 2004 followed by a 2.0% increase in production in 2005. Factors contributing to increased coal demand and production in 2004 include continued economic recovery, continued recovery in coal exports, return to normal weather patterns (colder winter weather), continued high natural gas prices, and settlement of legal issues affecting both coal producers and consumers (U.S. Department of Energy, Energy Information Administration, 2004§). Based on the coal production projections, explosives consumption is expected to increase in 2004 and 2005. Coal production was projected to increase slightly in the Appalachian region and more significantly in the western region and decline in the interior region. Because coal in the western region has a lower overburden-to-matrix ratio, explosives consumption is expected to grow at a rate slower than the rate of growth of coal production. Aberrations in weather patterns, however, could have a substantial impact on U.S. coal demand, because most coal is used for electricity production.

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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	2002	2003
Permissibles	1,360	1,070
Other high explosives	38,100	35,500
Blasting agents and oxidizers	2,470,000	2,250,000
Total	2,510,000	2,290,000

[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
2002:						
Permissibles	1	(3)	(3)	(3)	--	1
Other high explosives	5	17 r	1	12 r	2	38
Blasting agents and oxidizers	1,710	332 r	182 r	177 r	69 r	2,470
Total	1,720	349 r	183 r	189 r	71 r	2,510
2003:						
Permissibles	1	(3)	(3)	(3)	--	1
Other high explosives	5	15	1	12	3	36
Blasting agents and oxidizers	1,530	299	174	185	61	2,250
Total	1,540	314	175	197	64	2,290

[r]Revised. -- 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 1/2 unit.

TABLE 3

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

(Metric tons)

	2002				2003			
	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	25	650	53,000	53,700	29	663	61,100	61,700
Alaska	--	23	9,870	9,890	--	29	10,500	10,500
Arizona	40	601	79,000	79,700	40	508	66,100	66,600
Arkansas	--	377	11,100	11,500	(2)	164	9,930	10,100
California	1	827	52,300	53,100	2	765	41,500	42,300
Colorado	58	5,840	55,900	61,800	51	4,010	64,600	68,600
Connecticut	--	629	6,380	7,010	--	384	4,720	5,100
Delaware	--	--	--	--	--	1	63	64
Florida	--	172	17,300	17,500	--	202	17,000	17,200
Georgia	--	1,230	32,800	34,100	1	1,160	37,300	38,500
Hawaii	--	72	2,050	2,130	--	19	834	853
Idaho	5	159	11,300	11,500	(2)	111	12,600	12,700
Illinois	--	540	41,000	41,500	1	618	38,000	38,600
Indiana	3	1,130	220,000	221,000	38	1,070	204,000	205,000
Iowa	--	1,090	11,500	12,600	1	987	14,400	15,400
Kansas	--	215	7,320	7,530	1	723	11,100	11,900
Kentucky	780	1,990	312,000	315,000	439	1,410	264,000	266,000
Louisiana	--	339	2,190	2,530	--	639	2,230	2,870
Maine	--	16	1,220	1,230	--	17	1,460	1,480
Maryland[3]	2	105	5,490	5,600	3	122	8,030	8,160
Massachusetts	--	553	5,200	5,750	--	500	4,660	5,160
Michigan	--	101	19,600	19,700	--	71	20,400	20,400
Minnesota	--	184	40,300	40,500	--	159	51,000	51,200
Mississippi	--	16	73	89	--	12	64	75
Missouri	6	1,980	60,600	62,600	3	1,460	61,000	62,400
Montana	17	588	26,000	26,700	(2)	578	27,200	27,800
Nebraska	--	387	368	755	--	397	1,510	1,900
Nevada	--	3,080	96,900	100,000	1	2,400	41,000	43,400
New Hampshire	--	1,270	11,500	12,800	--	672	10,800	11,500
New Jersey	--	221	24,400	24,600	1	240	23,100	23,300
New Mexico	--	188	10,600	10,700	--	95	4,230	4,320
New York	--	611	14,800	15,400	(2)	478	14,300	14,800
North Carolina	--	794	34,400	35,200	15	814	29,900	30,700
North Dakota	--	12	1,340	1,350	--	4	1,910	1,910
Ohio	8	1,170	62,400	63,600	3	1,010	49,300	50,300
Oklahoma	2	328	17,900	18,200	2	447	16,800	17,300
Oregon	--	108	5,640	5,740	--	184	4,990	5,180
Pennsylvania	81	1,810	117,000	119,000	71	1,490	127,000	128,000
Rhode Island	--	73	2,090	2,170	--	98	1,340	1,430
South Carolina	--	158	5,190	5,350	1	139	4,960	5,100
South Dakota	--	11	4,890	4,910	--	3	4,490	4,500
Tennessee	5	1,420	30,400	31,800	68	1,120	30,300	31,500
Texas	1	697	41,800	42,500	18	457	40,200	40,700
Utah	29	544	72,100	72,700	37	555	81,300	81,900
Vermont	10	172	4,230	4,410	7	164	378	549
Virginia	163	1,670	159,000	161,000	106	3,300	141,000	145,000
Washington	60	1,400	20,300	21,800	(2)	1,030	14,800	15,800
West Virginia	19	1,170	363,000	364,000	121	719	331,000	332,000
Wisconsin	1	848	12,400	13,300	6	888	11,800	12,600
Wyoming	39	528	272,000	273,000	--	2,420	231,000	234,000
Total	1,360	38,100	2,470,000	2,510,000	1,070	35,500	2,250,000	2,290,000

-- Zero.

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

[2]Less than 1/2 unit.

[3]Includes the District of Columbia.

Source: Institute of Makers of Explosives.

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