EXPLOSIVES

By Deborah A. Kramer

In 1996, total U.S. production of explosives of 2.24 million metric tons was slightly lower than that of 1995, and sales of explosives were recorded in all States except Delaware. Coal mining remained the dominant application for explosives, accounting for about two-thirds of total sales. Unusual factors that led to record coal production are expected to return to normal in the next 2 years, and explosives consumption for this application is expected to grow slowly or decline, depending on the replacement of production from the Eastern and Midwestern States by production from the Western States.

The 1995 Oklahoma City bombing continued to affect the explosives industry. Under a new law, taggants (materials used to trace explosives by manufacturer) for explosives were the subject of a study to determine if such materials could be used to identify the manufacturer.

Legislation and Government Programs

In the wake of the Oklahoma City bombing in April 1995, the President signed Public Law 104-132 on April 24, 1996. The law, the Antiterrorism and Effective Death Penalty Act of 1996, included a provision for the Secretary of the Treasury to conduct a study of methods for tagging explosives for detection and identification and of the feasibility of decreasing the reactivity of common chemicals that are used in the manufacture of explosives, such as ammonium nitrate fertilizers. The study was mandated to be completed within 1 year from the enactment of the law. Any portion of the study that affected the regulation or use of fertilizers as a preexplosive material was to be conducted in consultation with nonprofit fertilizer research centers. Black powder and smokeless powder were excluded from the study.

In August, the U.S. Department of the Treasury funded the National Research Council (NRC) to execute the taggant and fertilizer study called for in the new law. The NRC will evaluate several options for taggants, as well as estimate costs for adding the material to explosives. Some of the taggants that already are being used commercially are (1) multicolored, multilayer plastic particles; code is based on color sequence of particles, (2) rare-earth elements embedded in synthetic granules blended with fluorescent pigments and iron powder; code is based on matrix melting point and composition of embedded elements, (3) isotopically labeled trace components of material being tagged; code is based on extent of substitution and proportion of substituted compounds, (4) inert chemicals identifiable by specific antibodies; code is the chemical identity, (5) polymeric microbeads with differing diameters and colors; code is based on population of various sizes and colors, and (6) slow-release microcapsules containing perfluorodimethylcyclohexane or perfluoromethylcyclohexane to enhance detectability. In a cost estimate completed by Microtrace Inc. (not part of the NRC study), taggants for explosives were estimated to cost about $133 per pound. At a concentration of 250 parts per million, the taggant cost would add about 3 cents per pound to the cost of the explosive material (Rouhi, 1996). Taggant producers claim that these materials can be added to commercial explosives and fertilizers without interfering with chemical reactions; explosives industry analysts, however, claim that the cost is prohibitive for materials that are priced as bulk commodities and that the quantity of explosives used in criminal acts is small.

In July, a Federal district court judge dismissed the class-action lawsuit against ICI Explosives filed in 1995 on behalf of victims from the Oklahoma City bombing. ICI Explosives argued that no known additive could have been added to the fertilizer to prevent it from becoming explosive when mixed with the fuel oil (Fertilizer Markets, 1996).

The Mine Safety and Health Administration published a final rule for safety standards for explosives at metal and nonmetal mines. This final rule revises existing standards for separation of detonators from other explosives and blasting agents during storage and transport. It also revises existing standards for loading and blasting of explosive materials and protection of explosives from impact and exposure to high temperatures (U.S. Department of Labor, 1996).

Production

Ammonium-nitrate base explosives (blasting agents and oxidizers) sales were 2.20 million tons, a decline of about 4% from that of 1995. Ammonium-nitrate base explosives accounted for 98% of U.S. industrial explosives sales. Sales of permissibles and other high explosives also declined; these sales dropped by 14%. Ten-year supply trends are shown in figure 1. *(See table 1 and figure 1.)*

Companies covered by this report, including those not members of the Institute of Makers of Explosives (IME), denoted by an asterisk, are as follows:

Accurate Energetic Systems
Apache Nitrogen Products Inc. *
Austin Powder Co.
Coastal Chem Inc. *
Amos L. Dolby Co.
Douglas Explosives Inc.
Dyno Nobel Inc.

El Dorado Chemical Co.
The Ensign-Bickford Co.
Explosives Technologies International Inc. (ETI)
Goex International Inc.
D.C. Guelich Explosives Co.
Halliburton Energy Services
HITECH Inc.
ICI Explosives Canada
ICI Explosives USA Inc.
LaRoche Industries Inc.
Maynes Explosives Co.
Mining Services International
W.A. Murphy Inc.
Nitram Inc. *
Nelson Brothers
Nitrochem Inc.
Owen Oil Tools Inc.
St. Lawrence Explosives Corp.
Schlumberger Perforating Center
SENEX Explosives Inc.
Sierra Chemical Co.
Slurry Explosives Corp.
Unocal Corp. *
Viking Explosives and Supply Co.
Western Atlas International

In November, Potash Corp. of Saskatchewan (PCS) announced that it would acquire Arcadian Corp. through an exchange of stock; Arcadian stock would be converted to PCS stock. The acquisition would include Arcadian's explosives-grade ammonium nitrate facilities in Memphis, TN, as well as its agricultural-grade ammonium nitrate facilities. A vote to approve the acquisition was expected to be held in January 1997 (Green Markets, 1996).

Consumption

Coal mining, with 65% of total explosives consumption, remained the largest application for explosives in the United States. According to the U.S. Department of Energy (DOE), the U.S. coal industry produced the largest quantity of coal ever in 1996, 959 million tons, a 2.3% increase from 1995 production. The electric power industry consumed record quantities of coal. Strong economic growth, colder-than-normal weather in the early part of the year, and high natural gas prices contributed to this record coal usage. Interfuel competition for the electricity generation market was the principal reason for a shift in regional coal production patterns. For the past several years, production of low-sulfur coal from the Western States was increasing at a greater rate than that of high- and medium-sulfur coal from the Eastern States. In 1996, coal output in the Appalachian and interior regions increased. Wyoming, West Virginia, and Kentucky, in descending order, led the Nation in coal production, accounting for 56% of the total (Hong, 1997). Kentucky, West Virginia, and Wyoming, in descending order, also were the three largest explosives-consuming States, accounting for 35% of total U.S. explosives sales. Ten-year consumption trends, by industry, are shown in figure 2. *(See figure 2.)*

Quarrying and nonmetal mining, with 14% of total explosives sales, was the second-largest consuming industry; metal mining accounted for 11% of sales, construction accounted for 7%, and miscellaneous uses accounted for 3%. Kentucky, West Virginia, Wyoming, Virginia, and Pennsylvania, in descending order, were the largest consuming States, with a combined total of 48% of U.S. sales. *(See tables 2 and 3.)*

According to Bureau of the Census statistics, the value of new construction increased by 1.9%, based on constant 1992 dollars (U.S. Department of Commerce, 1997). Federal Reserve Board indexes indicate that the industry growth rate for metal mining from 1995 to 1996 was 0.1% and that the growth rate for stone and earth minerals was 5.6% (Federal Reserve Board, 1997).

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.—Grades approved by brand name by the Mine Safety and Health Administration, as established by U.S. Bureau of Mines testing.

Other High Explosives.—All high explosives except permissibles.

Blasting Agents and Oxidizers.—Includes (1) ammonium nitrate-fuel oil (ANFO) mixtures, regardless of density; (2) slurries, water gels, or emulsions; (3) ANFO blends containing slurries, water gels, or emulsions; and (4) ammonium nitrate in prilled, grained, or liquor (water solution) form. Bulk and packaged forms of these materials are contained in this category. In 1996, about 85% of the total blasting agents and oxidizers was in bulk form.

World Review

Two new explosives-grade ammonium nitrate plants are being planned for Chile. ICI Explosives of the United Kingdom completed a feasibility study for a 220,000-ton-per-year ammonium nitrate plant near Santiago. The $40 million project has a projected startup date of the first quarter of 1998 (European Chemical News, 1996). The Chilean explosives producer Enaex was planning a 250,000-ton-per-year ammonium nitrate plant at its complex in Mejillones in northern Chile. Ammonia for the ammonium nitrate plant will be supplied by a new 120,000-ton-per-year facility being

constructed in conjunction with the State oil corporation. Total cost of the project is estimated to be $180 million. No startup date for the project was announced (Fertilizer International, 1996).

Kemira Group announced that it would sell 50.1% of its Vihtavuori subsidiary to the Finnish Government in 1997; this would effectively end the company's involvement with explosives and ammunition. The Government, which already owns 72% of Kemira, plans to acquire the explosives portion of the business for strategic reasons (Chemical Marketing Reporter, 1996).

Outlook

According to the DOE, coal production is expected to grow by 2.6% in 1997 and by an additional 3.0% in 1998. Production in the western region should continue to rise significantly over the forecast period, while production in the interior region declines and Appalachian region production grows slowly. In 1997, demand for electricity is expected to grow more slowly, at 1.0%, than it did in 1996. This is due mainly to the mild winter weather offsetting the effects of economic growth. In 1998, demand is expected to rise by 2.7% as the weather returns to more normal patterns and as the economy continues to grow (U.S. Department of Energy, 1997).

Consumption of explosives, however, is not expected to grow at the same annual rate as that of coal production. Because the largest production increase is expected in the western region, which generally has a lower overburden-to-matrix ratio, explosives consumption is expected to grow at a slower rate than overall coal production and may possibly decline if enough production in the Appalachian and interior regions is replaced by production from the western region. Natural gas prices are expected to stabilize, so interfuel competition will most likely be eliminated, and production of high-sulfur coal will decrease from the high level in 1996.

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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	1995	1996
Permissibles	3,420	2,510
Other high explosives	36,400	31,800
Blasting agents and oxidizers	2,240,000	2,200,000
Total	2,280,000	2,240,000

1/ Data are rounded to three significant digits; may not add to totals shown.

Source: Institute of Makers of Explosives.

TABLE 2
INDUSTRIAL EXPLOSIVES AND BLASTING AGENTS SOLD FOR CONSUMPTION IN THE UNITED STATES, BY CLASS AND USE e/ 1/ 2/

(Thousand metric tons)

Class	Coal mining	Quarrying and nonmetal mining	Metal mining	Construction work	All other purposes	Total
1995:						
Permissibles	3	(3/)	--	(3/)	--	3
Other high explosives	4	16	2	13	1	36
Blasting agents and oxidizers	1,490	292	248	152	66	2,240
Total	1,490 r/	308	250	165	68	2,280
1996:						
Permissibles	3	(3/)	--	(3/)	--	3
Other high explosives	4	15	1	10	2	32
Blasting agents and oxidizers	1,460	295	238	150	63	2,200
Total	1,460	310	239	160	64	2,240

e/ Estimated. r/ Revised.

1/ Distribution of industrial explosives and blasting agents by consuming industry in 1995-96 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 Bureau of the Census.

2/ Data are rounded to 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, 1996 1/

(Metric tons)

State	Class			
	Fixed high explosives			
	Permissibles	Other high explosives	Blasting agents and oxidizers	Total
Alabama	118	625	71,700	72,500
Alaska	--	1,010	8,770	9,780
Arizona	--	532	126,000	127,000
Arkansas	1	282	10,100	10,400
California	--	723	45,000	45,700
Colorado	--	397	7,340	7,740
Connecticut	--	657	6,390	7,050
Florida	--	223	31,600	31,800
Georgia	--	744	24,300	25,100
Hawaii	--	--	1,230	1,230
Idaho	1	664	12,600	13,200
Illinois	5	729	40,000	40,700
Indiana	1	527	126,000	127,000
Iowa	--	864	10,800	11,600
Kansas	--	523	16,000	16,600
Kentucky	1,170	2,390	352,000	356,000
Louisiana	--	277	2,230	2,500
Maine	--	53	486	539
Maryland 2/	--	168	5,010	5,180
Massachusetts	--	712	2,900	3,620
Michigan	--	162	28,000	28,200
Minnesota	--	234	44,200	44,400
Mississippi	--	83	73	157
Missouri	1	2,570	32,300	34,800
Montana	--	1,280	16,400	17,600
Nebraska	--	81	774	855
Nevada	23	1,760	71,600	73,400
New Hampshire	--	770	1,860	2,630
New Jersey	--	181	3,100	3,280
New Mexico	--	455	85,000	85,400
New York	--	615	12,000	12,600
North Carolina	--	748	25,500	26,300
North Dakota	--	119	2,960	3,080
Ohio	13	696	74,900	75,600
Oklahoma	2	323	22,700	23,000
Oregon	--	615	8,000	8,620
Pennsylvania	242	2,130	139,000	142,000
Rhode Island	--	2	92	93
South Carolina	--	109	4,920	5,030
South Dakota	--	74	7,830	7,910
Tennessee	33	1,610	30,800	32,400
Texas	(3/)	782	40,600	41,400
Utah	461	384	44,800	45,600
Vermont	3	124	394	521
Virginia	291	1,130	146,000	148,000
Washington	103	644	13,200	14,000
West Virginia	40	1,090	242,000	243,000
Wisconsin	--	592	14,300	14,900
Wyoming	--	342	189,000	189,000
Total	2,510	31,800	2,200,000	2,240,000

1/ Data are rounded to three significant digits; may not add to totals shown.
2/ Includes the District of Columbia.
3/ Less than 1/2 unit.

Source: Institute of Makers of Explosives.

FIGURE 1

SUPPLY TREND FOR U.S. INDUSTRIAL EXPLOSIVES

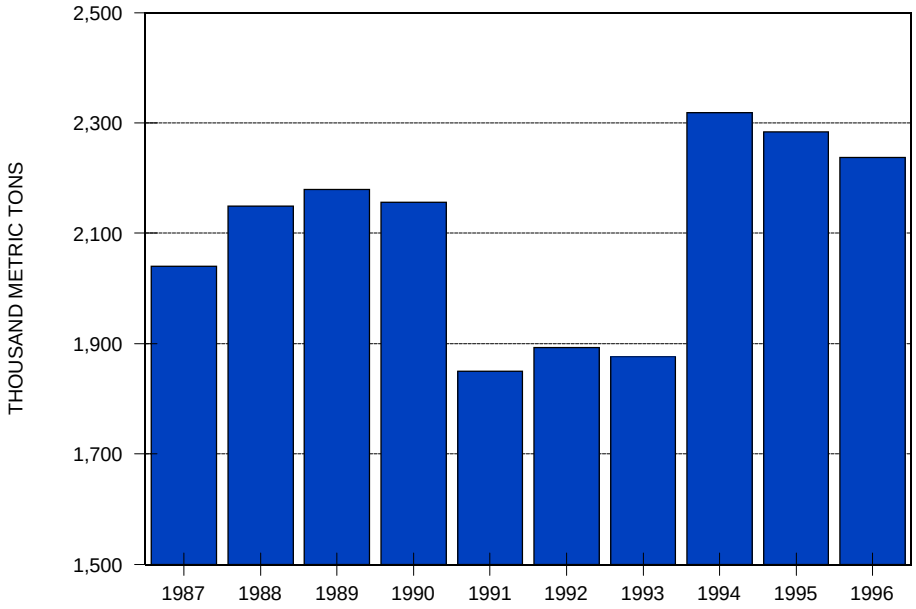

FIGURE 2

DEMAND TREND FOR U.S. INDUSTRIAL EXPLOSIVES