

EXPLOSIVES

By Deborah A. Kramer

In 1997, U.S. explosives production was 2.50 million metric tons, a 12% increase from the 1996 level; sales of explosives were recorded in all States. Coal mining, with 67% of total consumption, continued to be the dominant use for explosives in the United States. Kentucky, West Virginia, Virginia, Indiana, and Nevada, in descending order, were the largest consuming States, with a combined total of 48% of U.S. sales.

Coal production increased by 2.3% in 1997 and is projected to continue to grow through 1999. Most of the growth in production is projected for the western region, where there generally is a lower overburden-to-matrix ratio. As a result, explosives demand is not expected to grow as fast as coal production.

Legislation and Government Programs

Four lawsuits were filed against Farmland Industries Inc. and an affiliate, the Kansas Co-op Association, by survivors of the 1995 Oklahoma City bombing, alleging that the companies violated Federal and State laws by selling ammonium nitrate that was used to destroy a Federal office building. In July, Farmland filed a motion to move the cases to a Federal Court in Topeka from the State Court where the suits were originally filed. By yearend, no litigation had begun (Fertilizer Markets, 1997a).

In April, the International Fertilizer Development Center submitted its draft report on the ammonium nitrate industry to the Bureau of Alcohol, Tobacco, and Firearms. The report is part of an overall study of the use of taggants in ammonium nitrate. The study was mandated by Public Law 104-132, the Antiterrorism and Effective Death Penalty Act of 1996. Questionnaires on ammonium nitrate production and use were sent to North American and European producers in January to serve as a basis for the evaluation (Green Markets, 1997a).

In May, LaRoche Industries Inc. announced that it had reached a tentative agreement with the U.S. Department of Justice in a restraint of trade case that was filed in 1992. Under the terms of the agreement, LaRoche will pay a fine of \$1.5 million in five installments over the next 4 years. The case was originally filed by Thermex Corp. against Arcadian Corp. (now PCS Nitrogen), ICI Explosives, and Dyno Nobel Inc., as well as LaRoche. Although Arcadian, Dyno Nobel, and LaRoche eventually settled with Thermex, and ICI lost a court suit in 1995, Justice began announcing the results of its own investigations. PCS Nitrogen and El Dorado Chemical Corp. received Justice subpoenas regarding the restraint of trade case (Green Markets, 1997b).

Production

Ammonium-nitrate base explosives (blasting agents and oxidizers) sales were 2.46 million tons, a 12% increase from that of 1996. Ammonium-nitrate base explosives accounted for 99%

of U.S. industrial explosives sales. Production of permissibles in 1997 remained the same, and other high explosives production decreased by 8%. Sales for consumption of industrial explosives and blasting agents for 1996 and 1997 are shown in table 1. Figure 1 shows how sales for consumption have changed since 1988. (See table 1 and figure 1.)

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

Accurate Energetic Systems
Amos L. Dolby Co.
Apache Nitrogen Products Inc. *
Austin Powder Co.
Coastal Chem Inc. *
Davey Fire Inc.
Douglas Explosives Inc.
Dyno Nobel Inc.
El Dorado Chemical Co.
The Ensign-Bickford Co.
Explosives Technologies International Inc. (ETI)
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 Inc.
Nitrochem Corp.
Owen Oil Tools Inc.
PCS Nitrogen Corp.
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

Potash Corp. of Saskatchewan Inc. (PCS) completed its acquisition of Arcadian Corp. in March, and merged Arcadian into a wholly owned subsidiary of PCS, PCS Nitrogen Inc. The acquisition makes PCS the world's second largest nitrogen producer (Green Markets, 1997c).

Consumption

Coal mining, with 67% 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 1997, 988 million tons, a 2.3% increase from 1996 production (Hong, B.D., 1997, US coal supply and demand—1997 review, accessed July 8, 1998, at URL http://www.eia.doe.gov/cneaf/coal/cia/summary/cia_sum.html). The electric power industry consumed record quantities of coal, 2.8% greater than 1996 usage. The increase in coal production was attributed to a substantial decline in nuclear power generation and moderate growth in electricity demand. The rising demand for western low-sulfur coal for electricity generation, driven by its low cost and the sulfur emissions reduction requirements of the 1990 Clean Air Act Amendments, continued to boost coal production in the western region. This trend, however, slowed somewhat in 1997, as it did in 1996, because of strong demand for coals from Appalachia and the Illinois Basin in the East. A significant drop in nuclear-powered electricity generation in 1997, mostly in the East, contributed to the rise in demand for Eastern coal, which had been declining in recent years.

Wyoming, West Virginia, and Kentucky, in descending order, led the Nation in coal production, accounting for 56% of the total. Kentucky and West Virginia, in descending order, were the largest explosives-consuming States, accounting for 27% of total U.S. explosives sales.

Quarrying and nonmetal mining, with 13% of total explosives sales, was the second-largest consuming industry; metal mining accounted for 10% of sales, construction accounted for 7%, and miscellaneous uses accounted for 3%. Kentucky, West Virginia, Virginia, Indiana, and Nevada, 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 3.0%, based on constant 1992 dollars (U.S. Department of Commerce, 1997, December 1997 construction at \$611.8 billion annual rate, accessed July 8, 1998, at URL <http://www.census.gov/ftp/pub/const/C30/c309712.txt>). Federal Reserve Board indexes indicate that the industry growth rate for metal mining from 1996 to 1997 was -1.7%, and that the growth rate for stone and earth minerals was 1.9% (Federal Reserve Board, 1997, Industrial production and capacity utilization—Federal Reserve Statistical Release G17, accessed July 8, 1998, at URL <http://www.bog.frb.fed.us/releases/G17/Revisions/19971209/g17.pdf>).

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 National Institute of Occupational Safety and Health (former 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 1997, about 88% of the total blasting agents and oxidizers was in bulk form.

World Review

Empresa Nacional de Explosivos (Enaex) awarded a contract to Japan's NKK Corp. and Nissho Iwai Corp. to build its 350,000-ton-per-year ammonium nitrate plant. Plans for the new plant were announced in 1996, but Enaex has increased the plant's projected annual capacity by 100,000 tons. Completion of the plant is scheduled for 1998, and when finished, this plant will be the largest explosives-grade ammonium nitrate plant in the world (Fertilizer Markets, 1997b).

Current Research and Technology

Scientists at the Naval Research Laboratory developed a flow immunosensor that can detect explosives in soil and water in real-world conditions. The large number of military base closings has left the military with Superfund sites that need to be cleaned up before they can be returned to civilian use. Under current practice, soil samples from these sites are sent to an Environmental Protection Agency-approved laboratory for analysis; cost of this analysis is between \$500 and \$1,000 per sample with a turnaround time of 2 weeks to 1 month. The new device offers on-site analysis at a cost of \$3 to \$10 per sample. The immunosensor can detect either TNT (2, 4, 6-trinitrotoluene) or RDX (1, 3, 5-trinitro-1, 3, 5-triazacyclohexane) by coating a solid support with anti-TNT or anti-RDX antibodies whose binding sites are saturated with a fluorescent analog of either material. Samples are injected into a stream of buffer material that flows by the solid support. If there is explosive in the sample, it will displace the fluorescent analog, and the fluorescence can be measured by a detector downstream (Rouhi, 1997).

Outlook

DOE predicts that U.S. coal production will grow by 1.9% in 1998 and by an additional 3.0% in 1999. Production in the western region is predicted to rise faster than the average over the forecast period (6.0% in 1998 and 5.9% in 1999), and by 1998, the western region is expected to be the largest coal-producing area in the Nation (U.S. Department of Energy, 1998, U.S. coal demand and supply—Short-term energy outlook, accessed July 13, 1998, at URL <http://www.eia.doe.gov/emeu/steo/pub/coal.html>).

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. This trend is evidenced in 1997 with consumption of explosives by State. Despite the fact that Wyoming is the largest coal-producing State in the Nation, it ranks as the sixth-largest explosives consumer.

References Cited

- Fertilizer Markets, 1997a, Farmland hit with suits by OK City bomb victims: Fertilizer Markets, v. 8, no. 2, August 4, p. 3.
- 1997b, Japanese firms win contract for Chilean AN plant: Fertilizer Markets, v. 7, no. 29, February 17, p. 3.
- Green Markets, 1997a, Ammonium nitrate report submitted to ATF: Green Markets, v. 21, no. 14, April 7, p. 10.
- 1997b, LaRoche to pay \$1.5 million fine: Green Markets, v. 21, no. 20, May 19, p. 8.
- 1997c, PCS acquires Arcadian Corp., quickly restructures NPK giant: Green Markets, v. 21, no. 10, March 10, p. 1, 12.
- Rouhi, Maureen, 1997, Faster, cheaper way to find explosives: Chemical & Engineering News, v. 75, no. 16, April 21, p. 9-10.

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

(Metric tons)

Class	1996	1997
Permissibles	2,510	2,510
Other high explosives	31,800	29,400
Blasting agents and oxidizers	2,200,000	2,460,000
Total	2,240,000	2,500,000

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 1/ 2/

(Thousand metric tons)

Class	Coal mining	Quarrying and nonmetal mining	Metal mining	Construction work	All other purposes	Total
1996: e/						
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
1997: e/						
Permissibles	3	(3/)	--	(3/)	--	3
Other high explosives	4	12	1	10	2	29
Blasting agents and oxidizers	1,660	313	256	169	69	2,460
Total	1,660	326	258	180	70	2,500

e/ Estimated.

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 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, 1997 1/

(Metric tons)

State	Class			Total
	Fixed high explosives		Blasting agents and oxidizers	
	Permissibles	Other high explosives		
Alabama	44	720	104,000	105,000
Alaska	--	1,000	16,200	17,200
Arizona	--	514	126,000	126,000
Arkansas	--	258	11,100	11,400
California	--	723	34,000	34,700
Colorado	--	354	5,240	5,590
Connecticut	--	777	8,780	9,550
Delaware	--	3	108	111
Florida	--	186	9,690	9,870
Georgia	--	622	25,900	26,500
Hawaii	--	(2/)	1,300	1,300
Idaho	--	572	16,500	17,100
Illinois	(2/)	523	45,800	46,300
Indiana	1	680	165,000	166,000
Iowa	--	615	14,700	15,300
Kansas	--	482	33,000	33,500
Kentucky	1,310	2,360	408,000	412,000
Louisiana	--	227	2,270	2,500
Maine	--	74	355	430
Maryland 3/	--	139	5,150	5,290
Massachusetts	--	582	2,490	3,080
Michigan	--	51	29,000	29,100
Minnesota	--	178	56,600	56,800
Mississippi	--	76	639	715
Missouri	--	1,550	31,600	33,200
Montana	--	670	23,800	24,500
Nebraska	--	63	1,460	1,530
Nevada	88	1,600	126,000	128,000
New Hampshire	--	900	10,200	11,100
New Jersey	(2/)	195	5,950	6,140
New Mexico	--	557	80,600	81,100
New York	1	565	13,500	14,000
North Carolina	--	775	35,800	36,600
North Dakota	1	28	2,290	2,320
Ohio	12	568	81,500	82,100
Oklahoma	3	254	22,900	23,100
Oregon	--	283	7,440	7,720
Pennsylvania	140	1,740	120,000	122,000
Rhode Island	--	4	3,070	3,070
South Carolina	--	137	4,890	5,030
South Dakota	--	58	6,520	6,580
Tennessee	21	1,180	34,500	35,600
Texas	1	849	47,000	47,900
Utah	419	563	42,100	43,100
Vermont	5	152	314	472
Virginia	305	1,160	198,000	199,000
Washington	--	861	17,700	18,600
West Virginia	163	1,300	284,000	285,000
Wisconsin	--	459	15,800	16,200
Wyoming	--	1,220	126,000	127,000
Total	2,510	29,400	2,460,000	2,500,000

1/ Data are rounded to 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

