Belin Black Powder Plant
at
Moosic, PA
from
1972 - 1997

A History Of The Powder Plant
Under GOEX, INC. Ownership

Belin Plant History.

Construction of the du Pont's Belin plant began in 1908 and produced the first batch of black powder in 1912.

The Belin plant replaced the original black powder plant located a few miles north of Wilmington, DE and the du Pont black powder plant then located at Wapwallopen, PA. The Wapwallopen plant had originally been constructed by Parrish, Silver & Company and had been purchased by du Pont just before the Civil War.

These plants had served the anthracite coal mines that stretched in a belt from Scranton, PA westward to Shamokin, PA.

When the Belin plant began to produce black powder in quantity, du Pont closed both the Wapwallopen, PA and the Wilmington, DE powder plants.

In addition to the Belin plant, du Pont also operated black powder plants at Sycamore, Tennessee, Mooar, Iowa and Carney's Point, New Jersey.

By the 1960's, only the Belin plant continued to produce black powder which left it as the only operating black powder plant in the U.S.

As the war in Viet Nam wound down, du Pont decided that the black powder business no longer fit into there business structure. It was then decided to either close the plant or sell it to another company.

In 1972, du Pont sold the Belin Plant to Gearhart-Owen along with du Pont's powder making "technology". The "technology" being du Pont's methods and standards used in the process of manufacturing various types of black powder used for various applications.

Gearhart-Owen.

In the business world, with diversified corporations, the fate of individual divisions are largely determined by how the divisions are managed by the corporation's headquarters. In looking at the history of the Moosic, PA black powder plant, Belin Plant, it is necessary to take an in depth look at the parent company.

In early 1955, Marvin Gearhart and Harold Owen formed a company then known as Gearhart-Owen. The company was concentrated in the U.S. crude oil extraction business.

In 1965 the company went public on the stock market and the company name was changed to Gearhart-Owen Industries (GOI).

In 1969, Gearhart-Owen Industries purchased 432 acres of land near Cleburne, Texas and constructed a plant to manufacture military munitions. Production included hand grenade fuses and some missile parts.

When du Pont announced that they would be closing their Moosic, PA black powder plant, Gearhart-Owen Industries purchased the black powder business from du Pont to insure a supply of black powder for the munitions production in Texas.

Harold Owen had not liked being involved in the military munitions business and there were other areas of disagreement in the business.

The military munitions business went to Marvin Gearhart and was renamed GOEX International. Eventually to become part of Ensign-Bickford. The Moosic, PA black powder production business went to Harold Owen and became part of Owen's Pengo Industries located in Fort Worth, Texas. Pengo Industries was concentrated in the business of servicing oil wells. This included drilling truck manufacturing and the electronic monitoring of oil wells.

Throughout the 1970's this business was both highly competitive and highly profitable. These were the boom years in the oil business.

Pengo Industries had been incorporated, in Texas, on Oct. 3, 1977. On Nov. 1, 1977 Pengo Industries acquired all common shares of stock from Gearhart-Owen Industries. This included GOEX, Inc. and almost all of the assets of GOI's non-wireline operations.

To do so required Pengo Industries to set up Pengo Finance which borrowed heavily from various sources.

In 1981, Gearhart and Owen dissolved Gearhart-Owen Industries. The partners could not agree on the direction the business was taking and therefor dissolved the partnership.

In 1982, Pengo Industries began to divest a significant portion of its petroleum equipment manufacturing. This, in an attempt to raise money to cover debts incurred.

In 1985, the Securities and Exchange Commission halted trading in Pengo Industries stocks while the company attempted to restructure its debt.

In 1986 - 87, Pengo Industries continued to divest portions of the corporation.

In 1988, Pengo Industries's Pengo Finance was forced in Chapt. 11 Bankruptcy. The company underwent reorganization in 1989. Pengo Industries was then under the watch of a bankruptcy court into the mid-1990's.

To put this in its proper perspective relative to the operation of the Belin Plant at the time.

The parent company of the black powder business was in deep financial trouble. Non-profitable portions of the company were being sold off to raise money to save the parent company from bankruptcy. Those divisions of the parent company that were profitable were run with what might be termed fiscal restraint. Generally in industry such fiscal restraint limits employee wages and benefits. The only machinery maintenance permitted is that which is required to keep the product flowing off the production line. Such fiscal restraint usually also involves maximizing production at the lowest possible production costs. The push for maximum production possible becomes, in most cases, the main goal.

Experience in industry has shown time after time that this is not without a cost when it comes to the future operation of the plant. This cost will often manifest at a later point in time in labor/management relations and safety problems created by dispirited workers operating poorly maintained machinery.

Labor problems.

The present GOEX website company history relates: “GOEX fortunately retained most of the Du Pont employees (many of whom were third generation) and they brought the expertise and experience of their fathers and grandfathers into the new organization.”

After 19 years of operation under GOEX management the labor/management relationship at the Belin Plant clearly took another turn.

Quoting directly from a testimonial written on GOEX stationary, Belin Plant, on behalf of Blankenship And Associates, signed by F.L. Fahringer:

“In 1991 our plant in Pennsylvania encountered several labor law related issues and allegations that represented a very sizeable loss to our company. Further, such intrusions, unopposed, would have resulted in the loss of a great deal of control of our workforce.”

“Realizing the potential eminent damage and also recognizing the need for legal assistance in these matters, a search was conducted for a law firm specializing in labor law. This search eventually led us to Blankenship and Associates, who were highly recommended by others, and as a result of thorough reference checks, I retained this firm to represent and advise us in these critical matters. After several months relationship with Ray Blankenship, I can state for a fact that their high degree of competency and expertise in labor law immediately became evident. Their appearance in our matters and their representation of our corporation has given me the necessary assurance of our success. When things were at their worst, these people found a way out for us. In short, I don’t know if I could have made it through all the legal issues and government red tape without them.”

Signed by F.L. Fahringer, President.

This testimonial has been used by Blankenship And Associates to solicit business from employment agencies. This particular copy was sent to Action Staffing, in Reading, PA to solicit that company’s labor business.

The wording of the testimonial letter would lead one to believe that Blankenship was a law firm specializing in labor law. Defending a company against government charges of labor law violation.

The language used is: “law firm specializing in labor law.” “Our plant in Pennsylvania encountered several labor law related issues and allegations”.

Running Blankenship And Associates on an Internet search engine produces an entirely different picture of the situation at the Belin Plant. Almost all of the material will be found in the library of the NLRB web site.

Records from the Region 4 Office of the NLRB yielded the following information.

In Sept. 1992, Teamsters Local 229, IBT filed charges against Goex with the NLRB office in Scranton, PA. The union alleged that GOEX had violated Sections 8(a) (1) (3) (5) of the NLRA. Section 8 of the NLRA defines employer unfair labor practices.

The NLRB file card on GOEX shows the charges being filed on 8-26-92 with a resolution to the issue in 1993.

Additional information in this matter is to be found in the Establishment Inspection files in the Library Section of OSHA's web site.

Inspection date	Type	Mailing address	Workers' status
05-13-1986	Planned	Moosic, PA	non-union
05-16-1991	Accident	Minden, LA	non-union
05-20-1991	Accident	Minden, LA	non-union
02-21-1992	Complaint	Moosic, PA	union
04-22-1992	Referral	Minden, LA	non-union
06-30-1992	Complaint	Minden, LA	non-union
10-30-1992	Follow up	Moosic, PA	non-union
07-13-1995	Referral	Moosic, PA	union
06-04-1996	Referral	Minden, LA	union
04-17-1997	Accident	Minden, LA	union

This data shows that the Belin Plant production workers had elected to be represented by the Teamsters union in 1992. The organization of which had begun in 1991. Between Feb. 21, 1992 and April 22, 1992 the union election had been decertified and rescheduled for a later date. The NLRB file material suggests that the union won a subsequent, or second, election in 1993.

Then the question begs. How did Blankenship And Associates fit into this. Keep in mind that the testimonial describes Blankenship And Associates as "a law firm specializing in labor law".

To understand exactly what role Blankenship And Associates played in this and the allegations presented by the Teamsters union we might look to other NLRB cases where Blankenship And Associates was involved.

From the NLRB archives.

NLRB, Vol. 306, No. 205 - March 31, 1992
Blankenship And Associates are described as “labor relations consultants”.

United States Court of Appeals for the Seventh Circuit, April 13, 1995
Blankenship And Associates, Inc. and Rayford T. Blankenship
v.
National Labor Relations Board
Blankenship And Associates being described as, “a labor relations consultant”.

NLRB, Vol. 290, No. 557 - July 29, 1998
Case Name: Blankenship & Associates
Described as: “On April 4, 1986, the Employer contractually engaged the services of Respondent Blankenship And Associates, Inc. as the Employer’s representative in such NLRB case and any concurrent, subsequent or related cases, if any.”

NLRB, Vol. 329, No. 23 - Sept. 17, 1999
Wire Products Mfg. Corp.
Described as: “The Respondent’s agent, Ray Blankenship” “and Rayford T. Blankenship, Wire Products labor representative and designated bargaining representative.”

NLRB, Vol. 330, No. 166 - April 11, 2000
Bethlehem Temple Learning Center, Inc.
Described as: the Respondent’s consultant, Rayford T. Blankenship.”

At no point in the NLRB case files is Blankenship And Associates described as a law firm

The true function of Blankenship And Associates in the labor dispute at the Belin Plant in 1991 might best be envisioned by looking at another NLRB case involving a poultry packing plant then located at Scranton, PA in 1992. Scranton, PA being only a few miles from Moosic, PA.

NLRB Vol. 306, No. 205, Case 4-CA-16503-2, - March 31, 1992
Blankenship And Associates
Decisions Of The National Labor Relations Board
Blankenship And Asscoiates, Inc. and Rayford T. Blankenship
and
United Food and Commercial Workers International Union, Local 72, AFL-CIO-CLC.
By Chairman Stephens and Members DeVaney and Raudabaugh

"With respect to the first point, we review briefly Respondent's history of misconduct. For more than a decade, Blankenship's name has come before the Board as an agent who has committed repeated unlawful acts on behalf of the employer/clients who hired him. Respondent's pattern or practice of violations include; unlawful threats of loss of work or plant closing, unlawful undermining of support for a union by urging employees to bargain directly with the employer, overall bad-faith bargaining, locking out employees while engaging in bad-faith bargaining, and unlawful solicitation of grievances and promise of benefits."

The Board goes on: "Buntele's misconduct is all the more regrettable because he, unlike Blankenship, is an attorney licensed to practice law and, therefore, charged with an even higher duty to honor and respect the law."

This all explains the labor situation at the Belin Plant from 1991 into 1993. GOEX brought Blankenship in to the Belin Plant in an attempt to stave off union representation of the production workers or to in some way minimize the impact on the business that any gains union membership might produce for the workers.

To put this in a proper perspective relative to the operation of the Belin Plant at the time.

During the 1980's the production workers had been working for a company where the parent company had gone bankrupt. The usual tale in such matters is that wage increases are minimal as are increases in any company provided benefit packages.

Whenever a company undergoes union organization it creates a certain degree of dislike of the management within the workforce. If the union and the company fail to reach a working relationship it will often effect worker productivity and worker safety. The workers often become preoccupied in dealing with what they view as management's disregard for their rights as workers. Little disagreements are often blown far out of proportion. Workers no longer concentrate on the task at hand which becomes an invitation to a serious accident.

Plant safety record.

In 1970, then President Richard M. Nixon signed the Occupational Safety and Health Act, otherwise known as OSHA. OSHA simply mandated that an employer provide their workers with a safe place to work. Employers are required to look at their facility and take the necessary steps to insure that workers do not face an unnecessary risk of death injury or illness that could arise out of their employment. OSHA then began to write regulations that set standards and procedures that would limit risks in the work place.

OSHA maintains a web site library showing site inspections and any violations found and cited.

An employer's commitment to providing a safe work environment may be viewed from that company's OSHA record. There are a number of reasons that OSHA might have to inspect a particular employer's work site. OSHA lacks the number of inspectors that would be required to visit various employers on anything approaching regularly scheduled visits. They simply respond to site inspection requests after a particular plant has undergone an initial inspection. Plant accidents that result in serious injury will result in a plant inspection. OSHA will also perform follow up inspections to insure that previously cited plants made the mandated changes. Complaints from workers employed in the facility will result in a site inspection. If a particular plant is subject to inspection by other regulatory agencies, such as the EPA, the other regulatory agency may call in OSHA if they see violations of OSHA safety regulations.

Worker safety in any manufacturing operation is a collaborative effort on the part of both the workers and the plant management. If only one of the partners is truly interested in work place safety the plant's safety record will reflect the results.

While OSHA was created in 1970 it was not until 1972 that OSHA had inspectors trained and out in the field.

When the OSHA inspection record on GOEX, Inc.'s Belin Plant is viewed there are no OSHA inspections of the plant between 1972 and 1985. The first listed inspection of the Belin Plant being shown as May 13, 1986.

There was an incident at GOEX, Inc.'s Belin Plant in 1986 that was detailed in a 1987 volume of the Chemical Abstracts published by the American Chemical Society.

In 1986 a packing/sifting house at the Belin Plant blew up. While the building was destroyed, there was no injury to any of the workers.

A worker was detailed to change a light switch in a packing/sifting house. The worker removed the cover from the light switch box. Then attempted to remove the screws holding the wires to the switch. The screwdriver being used to loosen one of the connecting wire screws touched the side of the switch box. There was an arc. A spark consisting of a particle of heated metal landed on a building support that was covered in powder dust. The powder dust then began to burn like a slow fuse train. The worker quickly left the building and ran to get as far away from the building as possible. An explosion followed that involved an estimated 1,000 pounds of black powder.

OSHA has a program known as "Lock, Tag and Try". In an instance such as above, the worker locates the main electrical box that supplies current to the switch to be worked on. The main switch is thrown to the off position. The worker places a padlock through the switch handle, locking it in the off position. The worker would then put the key in a clothing pocket. Then go change the switch and close up the wall switch box. Then return to the main switch where the lock would be removed and the main switch turned back to the on position. Had the lock, tag and try procedure been followed, the explosion could not have happened.

The question being. Why did the worker not follow a safety procedure widely known and used? Was this type of work performance common? Did supervision monitor worker's to insure that they were following established safety procedures?

OSHA has long been accused by employers of "nit picking". In the above accident description we see why OSHA goes to great lengths to write safety procedures in almost minute detail.

Establishment Search - GOEX, Inc. -PA

Open Date	Type	Violations
05/13/1986	Planned	----------
05/16/1991	Accident	18
05/20/1991	Accident	5
02/21/1992	Complaint	3
04/22/1992	Referral	----------
06/30/1992	Complaint	2
10/30/1992	Follow Up	----------
07/13/1995	Referral	----------
06/04/1996	Referral	49
06/04/1996	Referral	----------
04/17/1997	Accident	4

The May 15, 1991 "accident" resulted in 3 fatalities. The OSHA inspect report describes this incident.

"At approximately 3:12 p.m. on May 15, 1991, Employee #1 was reportedly trimming a break in the linoleum covering the concrete floor in the sifter house. Employees #2 and #3 were cleaning the sifter house operation and removing oversize and undersize bags of black powder to an awaiting truck at the loading platform 75 ft away. Production for the day was complete and operations had been shut down. An explosion occurred in the sifter house, projecting fragments to the already bagged/stored powder on the platform/truck. Three to five seconds later approximately 700 to 750 lb of black powder exploded at the platform/truck storage area. Employees #1, #2 and #3 were killed. Employee #4, 420 feet away, was blown against a beam and suffered a back injury. He was taken by ambulance to the hospital and admitted."

Out of this incident, GOEX, Inc. later faced two wrongful death suits filed by survivors of two of the workers who had been killed in the explosion. Eventually settled out of court.

On April 16, 1997 there was an explosion at the Belin plant that resulted in 2 fatalities. This incident shut the plant down and GOEX, Inc. then made the decision to keep the Belin Plant closed and move the black powder manufacturing operation to Minden, Louisiana.

This incident involved the corning house and a cart of black powder sitting in front of the corning house.

The accident investigation suggested that the first explosion involved the cart of powder sitting in front of the corning house. This flattened the corning house which then blew up.

From 1991 to 1997 there were 5 fatalities at the Belin Plant as the result of two explosions. At that time the Belin Plant had 30 production workers who fell under OSHA regulations. In 1996 the number of "controlled" employees was 35.

When Gearhart-Owen purchased the Belin Plant from Du Pont they purchased a black powder plant that had been constructed in the first decade of the 20th century, a plant design that dated back into the mid to late 19th century. Such plants were not designed with worker safety as a major design criteria.

Goex's version of the history of the Belin Plant is seen on the present GOEX web site under the history section. "In the early 70's E. I. Du Pont withdrew from the manufacture of black powder and the Belin Plant eventually became part of GOEX, Inc. A rebuilding program ensued."

If the OSHA inspections in 1991 and in 1996 are examined in detail, the violations cited will indicate the plant's attitude towards worker safety and how well the plant was maintained.

<u>1991 citations.</u>
Fixed ladders - handrails.
Storage and handling of hazardous materials and explosives.
Lock, tag & try violations.
Fire prevention and fire brigade training.
Gear and shaft covers/guards.
Woodworking machinery - guards.
Electrical system design, components and maintenance.
Hazardous waste handling and emergency response.
Confined space entry.
Medical services and first aid.

Most of the machinery used to manufacture black powder at the plant was constructed of wood. The woodworking shop power saws lacked proper guards over moving parts and at the saw blades.

The rear end of the large powder polishing barrel lacked a cover over the large drive (bull) gear and a set of stairs was within inches of the gear. The stairs lacking handrails.

Charcoal and sulfur were ground in large ball mills known as "dust" mills. At the end of the shift a worker would enter the ball mills to sweep them out. Entering through an 18" hole. The workers were not provided with the proper respiratory protective gear. They did not use a life or safety line attached to the worker's belt. They did not test the interior of the barrels for hazardous dust or fume levels not for adequate oxygen levels. They did not use the lock, tag and try program when an operator entered the dust mill barrels.

Electrical systems supplying current to lighting systems and machinery drive motors failed to comply with explosion proof standards. Pieces of wiring conduit missing which meant the systems were then not properly grounded. Covers missing from wire junction boxes.

The condition of the plant might best be described as still being in the 19th century in mechanical safety. The electrical systems were simply poorly designed and poorly maintained by any standards.

1996 citations.

The citations issued in 1996 are almost a complete repeat of the citations issued in 1991.

To put this into perspective. The parent company, in the 1980's, was draining all of the profits away from the Belin Plant and would not budget enough money to the plant to allow for a minimum of building and machinery maintenance. The only maintenance permitted was that which was required to continue production of the powder.

Environmental concerns.

The Belin Plant was located a few miles from the East Branch of the Susquehanna River. The Susquehanna River emptying into the Chesapeake Bay In Maryland.

The Susquehanna River drains over half of the state of Pennsylvania which includes a large amount of farm land. The Chesapeake Bay suffered over fertilization from farm land runoff, municipal sewage treatment facility discharge and industrial waste water discharge. The various state governments formed a commission to address water quality problems in the bay. Regulations were enacted to control and limit the amount of nutrient materials entering into the various streams and rivers that eventually empty into the bay. The Susquehanna being considered a major source of these objectionable nutrients. Nitrates rate high on the list of the objectionable nutrients.

The Belin Plant had been in operation since 1912. The plant consuming vast amounts of sodium and potassium nitrate. The powder-making process creates large amounts of powder dust. A considerable amount of this powder dust being exhausted or escaping from the powder processing buildings. Which is then washed into the ground during periods of rain or snow or washed away into nearby streams during periods of heavy rain.

With most manufacturing operations within the state of Pennsylvania the plant is limited in the amount of nitrates that are released into the environment and must put in place suitable controls to prevent the release of nitrates above an allotment for that plant. In some cases it is necessary to collect storm water runoff for portions of the property and treat it before it may be released into nearby streams or pumped into a municipal waste treatment system.

Production of powder, technical issues.

Charcoal source.

When Gearhart-Owen (GOEX) took over the operation of the Moosic, PA Belin Plant, in 1972, the long-time supplier of charcoal was the Huskey Oil Company. The Huskey Oil Company charcoal producing plant was located in Bradford County, Pennsylvania about 20 miles South of the border with New York state. The charcoal manufacturing plant had originally been constructed to produce "wood chemicals" but for many years produced only charcoal. This type of charcoal had been used by Du Pont to produce blasting powders during the late 19th century and by the close of WWII this was the only type of charcoal in use by Du Pont. These wood chemical charring operations had used maple and beech wood to produce wood chemicals with the charcoal being a by-product of the process.

The Huskey Oil Company closed this charcoal plant in 1973. After years of use, the retorts were simply worn out and needed replacing. The charcoal business was simply not profitable enough to warrant the expense of rebuilding the plant.

Gearhart-Owen (GOEX) was then forced to purchase charcoal from another source. The new source of charcoal was the Roseville Charcoal Company of Zanesville, Ohio. The actual wood charring operation was located in West Virginia. This plant used kilns, rather than cylinder retorts, and charred mainly hard maple wood.

This change in charcoal was noted as a change in powder performance by some of the more experienced muzzleloaders.

Water quality.

When a batch of black powder is “laid up” in the wheel mill the operator will add water to the batch of powder prior to starting the mill. At the start of the milling cycle the batch will be about 10% by weight of water. Depending upon the climate, it may be necessary to add water at some point in the milling time. The batch of powder will loose moisture during milling but cannot be allowed to become too dry. When the wheel cake powder is “laid up” in the powder press it might be necessary to mist the powder with a little water to provide a desired moisture content during the pressing of the powder.

With black powder it is advisable that the water used in the powder be as pure as possible. The introduction of undesirable chemicals and microorganisms into the powder may dramatically effect the storage life properties in the finished powder.

The water quality problem at the Belin Plant had its roots in an incident that occurred On January 22, 1959. The incident became known as the Knox Mine Disaster. A coal mine in Port Griffith, PA, midway between Scranton and Wilkes-Barre, had been mining a coal seam from beneath the bed of the Susquehanna River. A mid-winter thaw had resulted in an early snow melt. The level of the Susquehanna rose to flood stage. The roof of the coal mine, formed by river bedrock, collapsed. The mine began to flood quickly resulting in the death of 12 coal miners. Since the entire area had seen deep mining of coal since the mid-19th century the tunnels were all interconnected. This event essentially ended the deep mining of coal in the Scranton, Wilkes-Barre and Pittston, PA area. With Moosic, PA being something of a suburb of Scranton.

With mining and mine water pumping ended the mine tunnels filled with water. The area’s water table stabilized with the level of the Susquehanna River.

By the mid-1960's the abandoned, flooded mine tunnels were seeping mine waste water into the area’s streams. Mine waste water being highly acidic and rich in dissolved iron. The state of Pennsylvania then began to seal any surface seepages that could be located. Shortly after that, deep well water became unsuitable for household use.

The Belin Plant normally used Moosic borough municipal system water for both drinking water and the “process” water used in the manufacturing of the powder. The Moosic borough system getting water from a small surface stream.

During periods of drought the small stream would give a limited amount of water. Area industries would the be ordered to minimize their municipal water system usage. The Belin Plant would then switch to an on-site deep well for their process water requirements. Well water rich in sulfuric acid and the various bacteria that cause mine waste water to form in the flooded coal mine tunnels.

Iron fixing bacteria feed on the iron pyrites in the rocks exposed by the removal of the coal veins. Iron pyrites being the sulfide form of iron. The elemental sulfur released by the iron fixing bacteria then becomes food for a group of bacteria known as sulfur oxidizing bacteria. The bacteria producing sulfuric acid as a metabolic waste product.

In 1982, the then president of GOEX was asked; “How long does it take to process a batch of powder?” The response; “Not long, we don’t leave it lay around.”

The importance of that response was to become evident by 1984-85.

A bit of historical background is in order at this point. Records pre-dating WWII were found in an Australian black powder plant once known as the Albion Works. Originally owned by the Australian government and operated under contract by ICI. The plant was salvaged and then torn down about 20 years ago. In a box were papers describing experiments run at this powder works in conjunction with other ICI black powder plants.

The little Australian plant specialized in the manufacture of small batches of very high quality black powder known as time ring fuse powder.

One technical paper goes into time ring fuse powder made with tap water and the same type of powder made using distilled water. The results of the experiments showed that the plant had to continue using distilled water in the powder and under no circumstances would regular tap water be acceptable in this particular type of black powder.

With time ring fuse powder. Consistent burn rate was a critical quality criteria and the powder was expected to exhibit the same burn rate after long storage that it exhibited when first produced. In essence. The powder had to exhibit a high degree of chemical stability with no measurable chemical change in the powder during varying periods of storage.

Which now leads us back to the water quality problem at the Belin Plant and what effect that had on the “quality” of the powder produced at that plant.

In 1986 there was a comment in a British black powder journal to the effect that the U.S. military had been investigating strange behavior in large-caliber artillery pieces that related to the black powder used in the intermediate primer systems.

Unclassified reports on this work were found in the library at the Aberdeen Proving Grounds, Maryland and available through the National Technical Information Service (NTIS). All of these papers being classified for public distribution.

Aberdeen Proving Ground’s Ballistic Research Laboratory begin to look closely at the black powder being used in the intermediate primer systems after a number of failures in large-caliber artillery. This included 3 inch and 5 inch naval gun mounts and a “catastrophic ammunition failure” in a 155mm howitzer in 1975.

Effect Of Black Powder Combustion On High And Low Pressure Igniter Systems
CPIA Publication 308, December 1979

Quoting the Abstract.

"The purpose of the program was to determine how the igniter system performance was affected by the black powder. At the same time, several conventional lots from two different black powder manufacturing companies were also tested in the igniters. Igniter action time was found to vary considerably depending on the lot used."

"A second motivation for this program came about from a hang-fire that occurred with the M203 charge used in the 155-mm howitzer. The origin of this problem was traced back to the igniter and to a specific lot of black powder used in these charges. The question is, what is the lot to lot variation in black powder combustion and how does it affect igniter performance?"

The ignition and combustion characteristics of black powder may be studied in a closed bomb test known as Relative Quickness, or RQ. With a sample of black powder in the pressure bomb, the RQ is the length of time from the moment of ignition until peak pressure is reached in the pressure bomb. Generally, in this test a specific sample of black powder is used as a "standard" or "control" sample. The time to peak pressure with the standard sample being used as 100%. The time to peak pressure with test samples then being faster or slower than the standard, or data greater than 100% or lower than 100%.

Closed bomb data, RQ.

Lot	Relative Quickness (Based on CIL 7-3)	
CIL 7-3	100.0%	
CIL 7-6	95.2%	
CIL 7-10	99.1%	
CIL 7-11	88.3%	(Spread of 11.7%)
GOE 75-2	107.7% (produced January 1975)	
GOE 75-7	131.1%	
GOE75-14	121.9%	
GOE 75-24	117.0%	
GOE 75-32	129.8%	
GOE 75-40	148.3%	
GOE 75-44	149.3%	
GOE 75-53	149.5%	
GOE 75-61	162.6% (produced December 1975)	(Spread of 54.9%)

There is seen a 54.9% spread in R.Q. between the January 1975 lot of primer powder and the December 1975 lot of primer powder. The January lot being almost 1 year older than the December lot.

In the MIL specification applicable to this type of powder a 20% reduction in burn rate with one year of storage is the maximum acceptable under the specification.

The trend in the data shows that as the powder aging the relative quickness decreased as a result. This being the result of a slowing of the burn rate of the powder. The slowing of the powder being the result of chemical changes having occurred in the powder during storage in closed containers.

The chemical changes within the powder involve the sulfur ingredient and the potassium nitrate. The end products of this chemical change are minute crystals of potassium sulfate scattered throughout the grains and the evolution of lower oxides of nitrogen. When the lower oxides of nitrogen are combined with traces of moisture they form nitric acid. Which then simply continue the process of chemical change. Initially the alkaline mineral matter associated with the charcoal ingredient will act as a buffer in this chemical change. Once the alkaline minerals are consumed the process of chemical change becomes a self-accelerating process.

Lengthy laboratory studies of this process of chemical change have shown that the extent of change is greatest in the surface regions of a grain of powder and the least degree of change at the center, or core, of the grain.

This process of chemical change effects the physical properties of grains of powder. Mechanical strength in the black powder is imparted at two points in the powder-making process. During the pressing of the powder the mass is compacted in a moist state. Contacting areas of the minute particles of potassium nitrate are brought together under pressure in a moist state. Being crystalline in nature, the particles begin to fuse together. When the slabs of pressed powder are removed from the press and exposed to air, the slabs will “cure”. This “curing” process simply involves an evaporation of a portion of the water within the mass of powder. The mass then being compact and cohesive, in addition to being rather hard. During the polishing of the powder, in the large glazing barrels, the surfaces of the grains of powder undergo additional compacting of the grains’ surfaces while a thin skin is formed on the grains’ surfaces. The skin, or glaze, being comprised of potassium nitrate and some of the mineral matter from the charcoal which migrated to the surfaces of the grains during the drying of the powder. The weight of the charge in the glazing barrel, coupled with friction between the tumbling grains, will fuse this migrated material into a somewhat solid glass-like film. Hence the term “glazed” powder. Under magnification, the surfaces of the grains will appear to have been coated with a thin film of glass.

When the grains of powder are subjected to chemical changes the grains become increasingly more friable. They slowly loose the degree of mechanical strength that was imparted by the pressing and polishing steps in the powder-making process.

The effect of that change in grain strength was investigated in another paper published by Aberdeen Proving Ground's Ballistic Research Laboratory.

Relationship Of Combustion Characteristics And Physical Properties Of Black Powder
Kevin J. White and Ronald A. Sasse
November 1982

Abstract.

Examination of closed chamber results and flamespread measurements in primer tubes indicates that grain break-up or deconsolidation may take place under conditions of vigorous ignition. It is suggested that mechanical properties may effect the ballistic performance of black powder. Evidence is also presented to show that the manufacturing process of black powder can effect the mechanical properties and, hence, the ballistic performance.

A. Various Methods Used For Flamespread Measurements

However, the PCRL device results and, especially the M28B2 primer measurements, may be affected by the mechanical properties of the black powder due to both the brisant initiator (M61) and to the confinement of the powder by the tube. For example, the propagation velocity (propagation velocity is the velocity of the flame front in traveling down the primer tube) of the M28B2 may be dominated by the mechanical properties of the black powder due to the sharp pressure pulse generated by the M61 initator. The PCRL flamespread device results show grain break-up only with Lot 11 and GOE 75-44. Both of these lots are wheel-milled, Gearhart-Owen black powder using maple charcoal.

These remarks are speculative and can only be proven by repeating the M28B2 primer tests using a very "soft" igniter such as a hot wire; measurement of the mechanical properties of the different lots may show significant differences. These tests have not yet been carried out.

IV. Conclusions

The general conclusions that can be drawn from this work are:

a. There is indirect evidence of black powder grain break-up under mechanical stress and pressure transients,
b. Grain break-up does not appear to be induced solely by combustion processes,
c. Mechanical properties should be considered in the performance evaluation of black powder.

The point is now reached where it would be appropriate to in some way illustrate a relationship between the purity of the water used in the manufacture of the black powder to any chemical changes in the powder during storage. It is actually possible to do so and at the same time illustrate the pattern of chemical change within a grain of black powder?

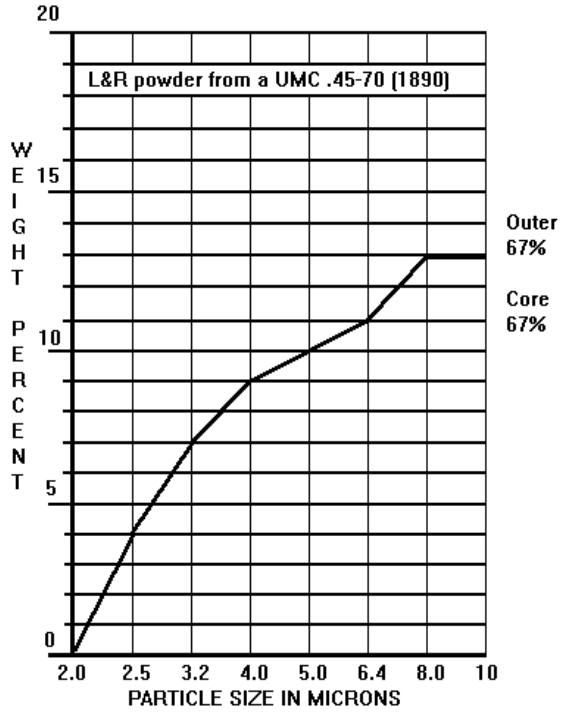
In the manufacture of the powder the charcoal and sulfur are first reduced in particle size in a ball mill prior to their use in a batch of powder in the wheel-mill. There is an additional reduction of ingredient particle size in the wheel mill. In addition, the wheel mill produces an extreme degree of uniform dispersion of the sulfur and charcoal particles throughout the greater mass of potassium nitrate particles.

Using a particle size distribution analyzer it is possible it is possible to produce a particle size distribution graph of the charcoal and sulfur particles in a sample of black powder.

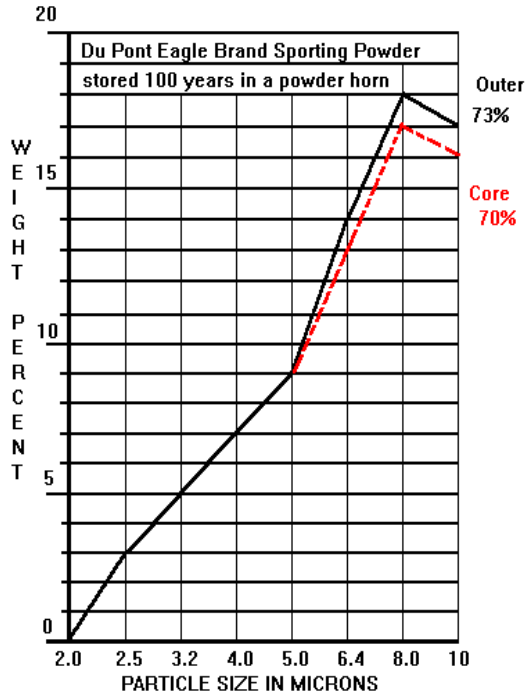
Refining the technique, it is possible to look for differences in ingredient particle size at different points in a single grain of powder. The greatest extent of chemical change would be seen in the surface or near surface regions of an individual grain of powder. The least amount of chemical change at the center, or core, of the grain.

Using this same particle size analyzer, another approach may be used. One of the end products of chemical change are minute crystals of potassium sulfate. These are not soluble in the 1% saline solution used in the particle size analyzer test method as a particle suspending medium. If the grains are broken down in layers, it is then possible to look at the near surface regions of the grain versus the core of the grain and judge extent of chemical change from the two graph lines.

A number of these graphs follow.



Graph 1.

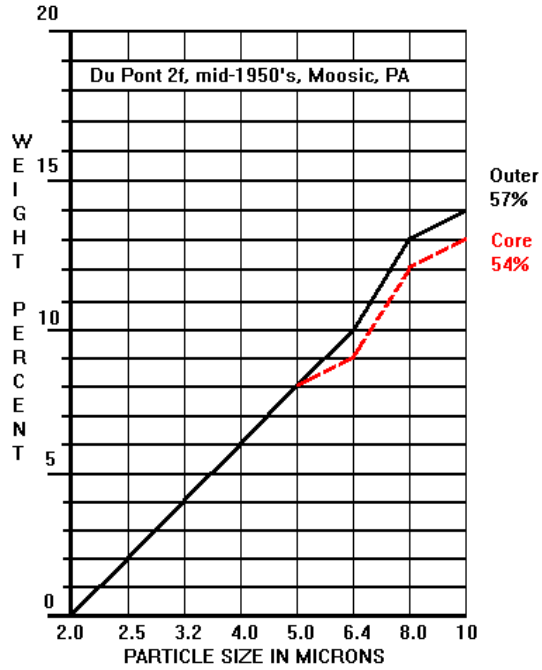


Graph 2.

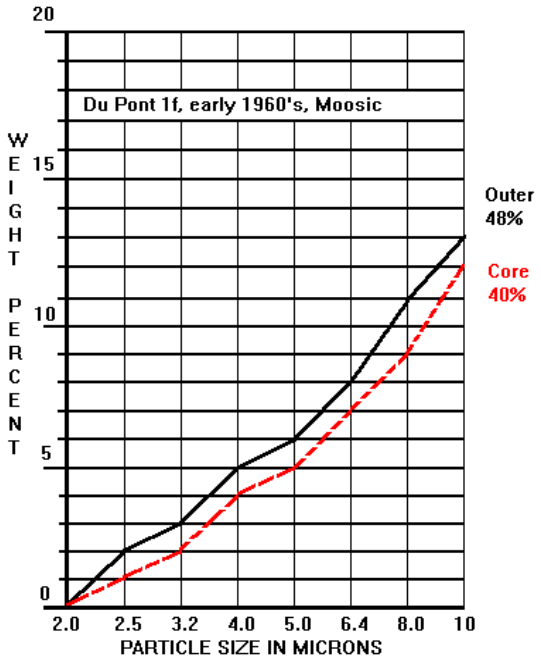
Graph 1. In this powder sample the particle size distribution of the charcoal and sulfur is the same from the exterior portions of the grain to the core of the grain and there is no evidence of chemical decomposition in the form of potassium sulfate crystals.
Graph 2. This powder sample showed a trace of chemical change as seen by the difference between the exterior portions of the grain and the inner core of the grain.

At the time these two powders were produced it was common practice to use only distilled water in the powder. The respective powder plants purchased raw saltpeter and refined it in their plants. Distilled water was used in the saltpeter purification process while the wetting of batches of powder in the wheel mills was done with water saturated with potassium nitrate obtained from the saltpeter purification building.

Generally, in the U.S. black powder industry, once powder companies ceased purifying their saltpeter on-site, they switched to what would be common tap water found in the plant.



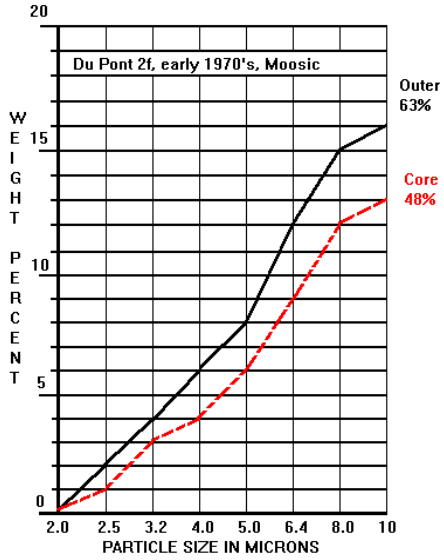
Graph3.



Graph 4.

Graph 3. This powder sample dates to the period in production at the Belin plant prior to the Knox Mine Disaster that occurred in 1959.

Graph 4. This powder sample was produced a few years after the Knox Mine Disaster. The onset of a problem with the chemical stability of Belin produced powder is seen in the difference between the two graphs.



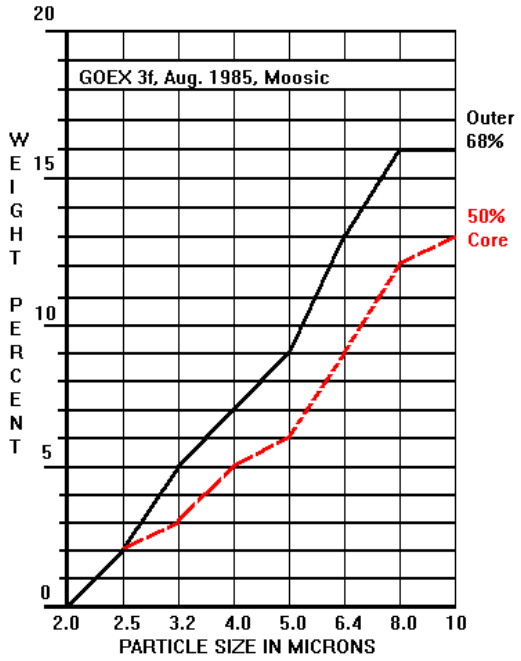
Graph 5.

Graph 5. This powder sample represents Belin Plant production just prior to the sale of the plant to Gearhart-Owen (GOEX).

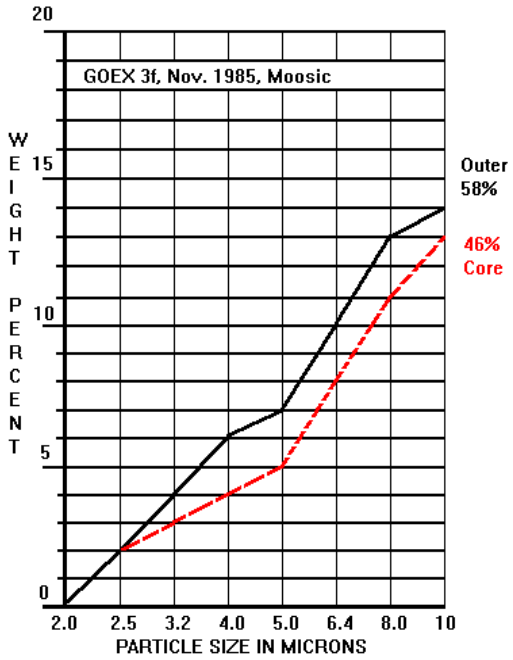
The data shows the onset of a period of drought that reached a peak in 1974 and 1975.

During periods of drought, the Belin Plant would cease using Moosic municipal system water in the powder and switch over to an on-site deep well where coal mine waste water would be pumped to the surface for use in the plant.

The graphs show an increasing problem due to a decline in water quality.



Graph 6.



Graph 7.

Graph 6. The area was again subject to a major drought in 1984 and 1985. This powder sample was produced at the height of the drought.

Graph 7. This sample is from powder production run during the first week of Nov. 1985. About two weeks after a hurricane dumped up to 6 inches of rainfall on the area in two days. The hurricane ended the drought of 1984-85 so the plant was allowed to switch from their on-site deep well to the Moosic Borough municipal water system.

Normally these periods of extreme drought had a past history of occurring in a pattern of 10 year cycles.

Another major drought occurred in 1988 into 1991. That proved to be the most severe drought in 145 years of weather record keeping in the area.

This 1988 into 1991 drought was to have a major impact on the future of GOEX's operation at the Belin Plant.

Competition from other manufacturers.

When the Gearhart-Owen company purchased the black powder business and production facility (Belin Plant) from du Pont in 1972 there was some concern among black powder shooters regarding the supply of black powder. Initially the company showed little interest in continuing to supply a rifle type powder to the civilian market shooters.

Leaders in the National Muzzleloading Rifle Association (NMLRA), at that time, spoke with officials at the powder plant in an effort to insure and continued supply of black powder to U.S. black powder shooters. Gearhart-Owen then agreed to continue supplying black powder for use in small-arms in the U.S.

At this time the only way that black powder could be shipped within the United States was with the use of special explosives trucks. This would then restrict availability in many areas of the country where sales volumes did not warrant the expense of shipment by special trucks.

Gearhart-Owen then approached the U.S. Department of Transportation and obtained a variance that would allow the shipment of black powder by "common carrier" trucking companies. The variance allowed black powder to be considered a flammable solid for purposes of shipping, in limited quantities, by common carrier. Shipments were limited to two 25-pound cases per truck.

This came at a time when black powder shooting was beginning to grow rapidly as a result of the U.S. Bicentennial celebration.

When Du Pont had initially announced that they were exiting from the black powder business there was a great deal of concern as to what supplies of black powder would be in the future. A short time later we saw one U.S. black powder company repackage a fireworks powder as a small-arms powder in different grain sizes.

Prior to Du Pont exiting the business there were rather small amounts of black powder imported into the United States. Small amounts of Curtis & Harvey (C&H) powder were seen for sale. The C&H powder made prior to 1970 was fast-burning and clean-burning. That made after 1970 was considerably inferior, being slow-burning and dirty-burning.

By 1973, Gearhart-Owen had the U.S. market for small-arms black powder all to themselves. In part due to the reputation of Du Pont powder from the Belin Plant. Gearhart-Owen claiming that they had changed nothing in the process after purchasing the plant, the business and the "technology" involved in the manufacturing of the powder.

On May 15, 1991 there was an explosion in one of the two sifting houses at the Belin Plant. This resulted in the death of 3 of the workers and serious injuries to a fourth worker. At the time there were about 30 to 32 production workers employed at the Belin Plant.

Production was then halted for sometime while the plant was brought up to the required standards of safe operation. OSHA listed 43 safety violations that required correction. Of the 43 citations shown, ten were deleted in the subsequent settlement reached between GOEX, Inc. and OSHA.

This incident caused some concern with Goex's large volume customers. GOEX's Belin Plant being the only producer of black powder in the United States. The financial condition of the re-organized parent company was not an unknown factor.

This incident resulted in the later imports of foreign-made black powder into the U.S.

In 1992, WASAG USA, the North American office for Germany's WASAG CHEMIE, brought one container of small-arms black powder into the U.S. Followed in a few months by a container of fireworks powders. The WANO small-arms powder was noticeably inferior to GOEX rifle powder and carried a higher price. WASAG CHEMIE soon closed down their North American office and little was heard about the WANO powder after that.

In Sept. 1992 a 33,000 pound container of Elephant brand black powder arrived in the U.S. Imported by Petro-Explo, Inc. from the S/A Pernambuco Powder Factory outside of Recife, Brazil.

The Elephant brand black powder was best suited to the larger caliber muzzle loading firearms. It was also less costly than GOEX powder. This powder was able to gain a foothold in the U.S. market and began to draw some sales away from GOEX.

During the mid-1990's, the S/A Pernambuco Powder Factory made a number of changes in their powder that made it more acceptable in a wider range of black powder small-arms being used in the U.S. Sales began to slowly climb.

In 1993, 102,670 pounds of black powder came in from Brazil. In 1994, the figure rose to 235,100 pounds.

In 1995, a series of fires and explosions at the S/A Pernambuco Powder Factory put it out of operation for 7 months while it was being re-built. Only 36,000 pounds of black powder came up from Brazil that year.

In the Spring of 1996 there was an incident at the Belin Plant that set the stage for the closure of that plant. During a passing thunderstorm, lightning struck a utility pole next to the corning house. The electrical surge traveler along the wires to a point where the wires attached to the corning house. This started a fire that totally destroyed the corning house and the corning mill that the building contained. This shut the Belin Plant down for a period of 6 months.

It was during this period of plant shut down where the value of an alternate supplier was seen. Following the loss of the corning house, GOEX attempted to purchase Elephant brand black powder for resale by GOEX. An agreement suitable to both parties could not be reached.

The inventory of Elephant brand black powder in the U.S. did prevent any widespread shortages of black powder during the period of time that the Belin Plant was out of production.

The Belin Plant went back into production in Nov. 1996.

Then on April 16, 1997 there was another explosion at the Belin Plant. The two explosions resulted in the destruction of the corning house that was built in 1996 and the corning mill that was reconstructed in 1996. So the plant had only been back in operation for a period of 6 months. Within a few days after this explosion GOEX decided to close the Belin Plant and move the operation to the property near Minden, Louisiana.

Since the Belin Plant had run only 6 months between these two incidents they had been unable to build up a large inventory of powder. By August of 1997, Elephant had increased their imports to make up for the loss of the Belin Plant's production. Bringing almost 250,000 pounds of black powder up from Brazil.

Following the April 1997 explosion and closure of the Belin Plant, GOEX again attempted to purchase black powder from the S/A Pernambuco Powder Factory in Brazil.

When GOEX closed the Belin Plant, in 1997, they salvaged some of the machinery for use at the Minden, LA plant then under construction. The large Du Pont designed wheel mills were simply left sitting at the Belin Plant. Minden then being set up around (5) 5-ton wheel mills salvaged from a closed black powder plant in South Africa. This decision was to have a major impact on the operation of the Minden plant in the following year.

During the period 1993 to 1997 there was something of a love/hate relationship between GOEX and Elephant.

When GOEX had a local shooter test Elephant brand black powder in 1993 the shooter used a .45 caliber longrifle. The Elephant at that time had a musket powder burn rate. So in the medium caliber round ball rifles it would be slow (weak) and foul the bore to a greater extent, compared to GOEX's rifle burn rate powder. GOEX officals then describing Elephant brand black powder as cheap and dirty.

On Nov. 29, 1994, an official from GOEX, at the Belin Plant, sent a fax to the Director of the S/A Pernambuco Powder Factory, Recife, Brazil.

The fax describes how in 1993 the Director of the S/A Pernambuco Powder Factory visited Pengo Corporation's office in Sunnyvale, CA. The Director had discussed supplying the U.S. with black powder and asked as to the possibility of purchasing GOEX, Inc.

The fax reads:
"We in turn expressed an interest in possibly importing and distributing "Elephant" Black Powder if the quality could be brought up to U.S. standards. You were receptive to this and offered your invitation for our representatives to visit your factory in N.W. Brazil."
"If this invitation is still open we would like to begin talks and arrange a possible visit in early 1995. We, of course will need your assistance with the travel arrangements."

At the subsequent meeting in 1995, GOEX expressed an interest in importing up to 1 million pounds of Elephant brand black powder per year if the plant could produce their powder to GOEX specifications.

The behavior of both parties here is questionable. The S/A Pernambuco Powder Factory had contracted with Petro-Explo, Inc., here in the U.S., to act as their exclusive importer and distributor within the U.S. and Canada.

Between 1995 and 1999 there were additional attempts, by GOEX, to import Elephant brand black powder and to purchase spare parts for the 5-ton wheel mills used at the new Minden, LA plant. The S/A Pernambuco Powder factory used the same 5-ton wheel mills. Since Krupp, in Germany, ceased producing these wheel mills in 1985, the spare mills and spare parts have become highly prized in the industry.

The manufacture of fireworks powders had at one time represented a major portion of the production at the Belin Plant.

During the period, 1990 to 1999, there was a dramatic increase in the amount of fireworks being shipped to the U.S. from the Peoples Republic Of China.

Initially the growing imports of fireworks had little impact on U.S. production of black powder. The lifting charge powders used by the Chinese fireworks producers were not to be trusted. Those fireworks display companies using Chinese-made aerial shells would remove the lifting charge attached to the shells and discard that powder. To be replaced by charges of lifting powder produced by GOEX.

By about 1995, the Chinese fireworks producers were getting a grip on the issue of lifting charge powder standards. Display companies then began to use the lifting charges supplied with the shells.

In 1990, pyrotechnic articles worth $47,000 were imported into the U.S. By 1999 this had climbed to $126,000 in value.

Chinese-made black powder comes into the U.S. at prices below $1 per pound.

By the mid-1990's the Chinese black powder producers had begun to more aggressively market their powders throughout the world markets for black powder. This cut into GOEX's exporting business. So the effect of the Chinese black powder was somewhat twofold in nature. Other black powder producers around the world also suffered from the Chinese powder-makers drive into the world market.

The closure and abandonment of the Belin Plant in 1997 essentially ended Du Pont's influence in black powder production in the U.S.

Feb. 2002
Wm. A. Knight
Reading, PA

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Postscript ..... of sorts.

The original version of this paper had been written early in 2002. A part of the story of GOEX's operation of the Moosic, PA black powder production facility could not be told in public or in detail. Now in 2007 the story made be told.

The author's involvement in this began in 1983 while extracting potassium nitrate (saltpeter) from various lot of GOEX powder produced at the Moosic plant. Laboratory work showed that in the finished powder the purity of the potassium nitrate would run between 95 and 97% purity. This suggested the use of a fertilizer grade of potassium nitrate and not a technical grade. A technical grade would be 99.5% purity.

One of the author's friends wrote a magazine article on black powder and had a one line comment that in the U.S. black powder was being produced using fertilizer grade potassium nitrate. The response out of the then president of GOEX was rapid and nasty. He threatened to sue the magazine that published the article. He then threatened to sue the writer of the article. Then threatened to sue the author who had provided the original information.

The author spoke with the man on the telephone. He insisted that GOEX was purchasing technical grade potassium nitrate from their supplier, the Vicksburg Chemical Company of Vicksburg, Mississippi.
It was suggested, to him, that he have a good laboratory do a detailed chemical analyses on samples of the potassium nitrate shipped to him. That once he had such information in hand he could get in touch with the author and it would be discussed as to just who would sue whom. Nothing more was heard out of the man for about 6 months. The author called him for an update. The president of GOEX was more subdued and would only comment that their supplier was thinking of suing. They were invited to give it their best shot.
The author had spent a good bit of time in industry. When the president of GOEX reacted the way he did it was a clear indication that something was being hidden from view.
A good bit of time and effort was put into some research into GOEX's source of potassium nitrate between the initial contact and the second more subdued conversation.

The plant that supplied GOEX with potassium nitrate was constructed in 1965 by the Vicksburg Chemical Company at Vicksburg, Mississippi. Going into production in 1968. The process used to produce potassium nitrate involved a reaction between potassium chloride and nitric acid. Yielding potassium nitrate and free chlorine gas.

The potassium chloride feed stock came out of salt mines located around Carlsbad, NM. The mine produced various salts normally associated with salt beds underground. The mined "ore" was brought to the surface where it was ground to pass through a 40 mesh screen. The ground ore was then subjected to a flotation process that separated sodium chloride from potassium chloride using a modified tallow soap that had a specific attraction for the potassium chloride. The dried potassium chloride then being shipped to the Vicksburg Chemical Company facility for conversion to potassium nitrate.
The flotation process also resulted in the carry over of about 0.5% of sodium chloride which would appear as sodium nitrate in the finished potassium nitrate. There was also a carry over of some colloidal clay and pieces of grey colored gravel. In the finished potassium nitrate one would find a good bit of this brown clay and the grey colored gravel. One would also find a small amount of the modified tallow soap used in the ore separation flotation process. After the conversion process at Vicksburg Chemical Company one would also then see pieces of wood in with the beads of potassium nitrate. The bits of wood being added as Vicksburg's wooden holding tanks fell apart.

The 1974 copyrighted Lyman Black Powder Handbook contains an article on GOEX's black powder plant at Moosic, PA. The article shows a photo of the then plant manager in front of a large pile of potassium nitrate. The article goes on to state: "The nitrate is fed into a crusher-feeder which breaks up lumps formed during storage at the supplier's. A conveyor belt moves the substance to a vibrating screen where the coarser particles - and foreign matter - are stopped and swept aside for proper handling. Stubborn chunks of nitrate will be broken up and recycled while foreign objects like sticks and stones are discarded."

The presence of the "sticks and stones" is in itself a form of proof that the potassium nitrate is a fertilizer grade and NOT a technical grade. Working with a bag of potassium nitrate produced by Vicksburg Chemical Company at the time. The sticks, stones and brown clay would vary from 1% to 1.5% of the starting weight. That alone showed it was not 99.5% purity as received.

Vicksburg Chemical Company's process was one of the most efficient versions of the basic conversion process in use at the time. This use of nitric acid to convert potassium chloride came into widespread use during the 1950's and 1960's. The process used at the Vicksburg plant had a 98% conversion efficiency rating. The plant simply could not produce a true technical grade at 99.5% purity without additional purification steps which they could not do. Depending on how fast they pushed the conversion process final purity could drop to as low as 90% conversion.

In the U.S. 95% of the potassium nitrate used is used for agricultural purposes. Five percent of the total amount consumed goes into other industries. When used as a fertilizer on "chloride sensitive" crops the presence of sticks, stones and clay is of utterly no consequence.

The presence of about 0.5% of sodium nitrate in with the potassium nitrate resulted in the GOEX black powder being more hygroscopic than if a sodium free potassium nitrate is used.
In one test the Vicksburg Chemical Company potassium nitrate was compared to high-purity potassium nitrate out of Hiafa Chemical Company in Israel.
Pure potassium nitrate has little affinity for moisture in the air. When the Relative Humidity is below 92% the potassium nitrate will pick up only a fraction of a percent n weight. Above 92% R.H. the potassium nitrate will pick up greater amounts of water from the air. This test was once used by the C&H powder company to test the purity of their potassium nitrate. The basis being that at 92 to 99% R.H. the maximum increase in weight in a sample of potassium nitrate being tested would be 1.6%. Over half of that figure not being gained until the R.H. exceeds the 92% level. In a side by side test the Vicksburg Chemical Company potassium nitrate picked up 16% by weight while the Haifa Chemical Company potassium nitrate picked up only 1.6%.
In essence. The inclusion of only 0.5% of sodium nitrate in with the potassium nitrate has an effect far out of proportion to its percentage when included in the black powder.

From 1984 thru 2000 GOEX insisted the author was wrong and nothing more than a trouble maker.

Then in 2000 GOEX was informed by the Vicksburg Chemical Company that they would no longer be able to supply GOEX with potassium nitrate. The Vicksburg, Mississippi plant was being closed and Vicksburg Chemical Company would be filing for bankruptcy.

There was more than a bit of panic at GOEX over this. Vicksburg Chemical Company had been the only commercial producer of potassium nitrate in the U.S. for close to 30 years. The only other producer was part of a farm co-op and did not sell its product outside of that group. So having never used any other supplier GOEX did not know what to expect in a change to another source.
Vicksburg Chemical Company's closure did not create a sudden lack of supply in the U.S. A large facility in Chile had come on line producing potassium nitrate in a more pure farm and at a slightly lower cost. When GOEX made test batches of powder using the potassium nitrate from Chile the field test responses were very positive. That it was a noticeable improvement in the powder's performance in the gun.

The author had a chat with the president of GOEX in early 2006 who expressed some bitterness over the slight of hand that had been played on GOEX all those years.

So after 22 years the author was vindicated.