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Issues related to the cessation of special production in chemical plants
Problematyka związana z likwidacją produkcji specjalnej w zakładach chemicznych

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Abstract: *Changes in ownership, changes in technology, unprofitable production and other causes, force manufacturers to cease production of explosives in chemical plants. This process is well-controlled in some plants, and abrupt in others, without proper control or the required safety measures. Frequently, plants used previously for the production of explosives and explosive compositions change production or are retrofitted without prior cleaning or, after ceasing production, are left without appropriate supervision which may lead to serious or even fatal accidents. The issues of cessation of special production are discussed using examples.*

Streszczenie: *Zmiany własnościowe, zmiany technologiczne, nieopłacalność produkcji i inne przyczyny wymuszają likwidację produkcji materiałów wybuchowych w poszczególnych Zakładach Chemicznych. W niektórych zakładach zmiany te wprowadzane są w sposób kontrolowany, w innych w sposób chaotyczny, bez kontroli i zachowania odpowiedniego poziomu bezpieczeństwa. Często obiekty, w których wcześniej prowadzona była produkcja specjalna mająca na celu otrzymywanie materiałów wybuchowych lub kompozycji wybuchowych, zmieniają swoje przeznaczenie i są remontowane bez wcześniejszego ich oczyszczenia lub też po likwidacji produkcji pozostawione są bez należytego nadzoru. Prowadzi to do groźnych lub nawet śmiertelnych wypadków. Problematyka likwidacji produkcji specjalnej została omówiona w referacie na przykładach.*

Keywords: *special production, explosives, accidents*
Słowa kluczowe: *produkcja specjalna, materiały wybuchowe, wypadki*

1. Reasons for changes in production of explosives in chemical plants

The turn of the 1980s and 1990s marked great changes in all areas of life in Poland. The transformation has also affected the chemical industry, including production of explosives. The changes were extensive and some still continue in the second decade of the 21st century. Changes in the production of explosives are usually caused by:

a) changes in technology,
b) cessation of production due to transfer to another plant,
c) cessation of production due to unprofitability,
d) cessation of production due to plant bankruptcy.

The changes in production of explosives due to transfer to another plant and bankruptcy are discussed below.

2. Cessation of hexogen production in Organika-Sarzyna chemical plant

The hexogen production plant at the Organika-Sarzyna chemical plant in Nowa Sarzyna, was established in the 1950s based on Soviet technology and documentation. The plant consisted of several production stages in individual, mounded buildings including:

- a nitration building,
- a drying facility,
- vacuum pump facilities,
- a packaging facility,
- a storage area, and
- storage bunkers.

The main and auxiliary plant were located in the woods and surrounded by a fenced area. The plant was referred to as Department 100.

At the end of the 1980s, the production of hexogen ceased due to limited demand, and the plant was maintained in a state of readiness, financed by the Ministry of National Defence. As soon as financing stopped, Organika-Sarzyna chemical plant decided to decommission the plant. As part of the departmental arrangements, hexogen production was transferred to the Nitrochem chemical plant in Bydgoszcz. Production continued using a new plant based on modified technology. The Sarzyna plant was gradually dismantled. The process plant was decommissioned first. The equipment was washed with lye and fired. In this period, several cases of theft (in particular piping) was reported. One of the incidents turned tragic, when explosive in the pipeline being cut with a gas torch, detonated and killed one person. The drainage system was decommissioned next, and approximately 500 kg of pure hexogen was retrieved. The decommissioning was carried out by the plant's personnel.

In 2007, the demolition of Department 100 buildings, by a specialized company, was ordered. Due to dense reforestation, the buildings were not cleaned by firing before demolition. The company decided to demolish the buildings using explosive microcharges. Before demolition, the building was washed with water daily and the blasting holes were drilled under a water stream. First, the floors and equipment foundations inside the building and then the internal and external walls were demolished. During detonation of the microcharges, effects of micro-remnants of hexogen were observed (increased noise and intensified explosive effect). The debris was loaded onto tipper trucks under under a stream of water and transported to the local wastewater treatment plant. The debris was used as a base course for the slab road to facilitate the restoration of the settling tank.

Figure 1 shows the view of the nitration building prepared for demolition and Figure 2 shows the effects of demolition of parts of the building. Most buildings of Department 100 were demolished using this method, except for some auxiliary buildings (where no hexogen production was carried out) and reinforced concrete storage bunkers located deeper in the woods. This example of cessation of explosive production can be considered correct, prioritising the safety of personnel and property.

(a)

(b)

Figure 1. Nitration building: (a) general view; (b) nitration building wall with demolition charge holes

(a)

(b)

Figure 2. Nitration building during demolition: (a) demolished side walls, prepared for further demolition, (b) view after partial demolition

3. Cessation of explosives production in Pronit-Pionki Plastics Production Plant

The Pronit Plastics Production Plant in Pionki was the manufacturer of various explosives, including dynamite, ammonite, priming materials, nitrocellulose, propellants, plastic explosives *etc*. It is difficult to accurately determine an exact date when the decision to close the plant was made, since even the law enforcement agencies had difficulty in finding persons responsible for leaving explosives unattended and determining the relevant time period. The court declared the plant bankrupt in 2000 and assigned an official receiver. 1500 people lost their jobs. Before that, individual plant departments ceased production day by day, leaving the plants unsupervised. In 2005, the Pionki Municipal Council purchased the Pronit plant from the official receiver. In 2011, the then mayor of Pionki said „*based on the information obtained from the official receiver, in the notarial deeds and in the inventorying commission report there was no mention of any explosive materials remaining at the Plant*". At the beginning of that year, just before the mayor's declaration, at the initiating materials department, a young person died as a result of a tragic accident. An on-site visit showed that initiating explosives were present in both the production facilities and the surrounding area [1].
Figures 3(a) and 3(b) show the view of the production building at the Pionki plant and the interior with the wooden crates used for transporting explosives. Figure 4 shows the interior of the building, including production equipment and the remainder of reagents in glass and plastic containers. Figure 5 shows the interior of the production building and the press, where the fatal accident took place.

(a)

(b)

Figure 3. The production building in Pronit plant: (a) outside view, (b) interior with explosives transport packaging

(a)

(b)

Figure 4. Interior of the building including the production equipment and the remainders of reagents in glass (a) and plastic containers and metal drums (b)

(a)

(b)

Figure 5. Production building: (a) table with scale pans for explosives; (b) drift in which the fatal accident took place

The production process at the department described below is key to the case. The walls and floors of the production facility were rinsed with water before and after every shift. The water was drained to a sedimentation tank *via* concrete troughs. Because of this, the presence of explosives in the floors and under the floors, in the production facilities, as well as near and under the troughs needed to be considered. In 2011, the plant advertised for tenders to demolish part of the department's buildings. The cheapest offer was selected and the tender was awarded to a contractor without a license to work with explosives. As a result, the tender was invalidated, and after several months, a licensed company, dealing with demolition using explosives, was selected [2]. A similar situation existed at the PA (nitrocellulose production) and PG (propellant production) departments. Nitrocellulose production ceased in the mid 1990s. In 2001, the Special Production Plant in Pionki had been producing nitrocellulose for several months, leasing the equipment and plants in the Plastics Production Plant. An attempt to reactivate nitrocellulose production failed due to obsolete technology and equipment. The required production quality could not be maintained.

In 2012, an explosion occurred in the nitrocellulose production department, killing two people. The Municipal Council attempted to locate the contaminated areas, and secure the means for decontamination and disposal of nitrocellulose. Approximately 240 tonnes of nitrocellulose were identified. In 2015, following a successful tender, decontamination was attempted by the Military Institute of Armament Technology. Within 4 months, the nitrocellulose was extracted and removed from the plant. The biggest hazard was a settling tank filled with nitrocellulose. The explosives were found in the inspection chambers, drain pipes and wooden troughs removing rinsing water from the sector. Deposited nitrocellulose was found down to a depth of approximately 80 cm under the wooden troughs. During normal production, the troughs were periodically cleaned, and their contents thrown aside, forming nitrocellulose mounds. Figures 6 and 7 show the location at the production area where nitrocellulose was left in the tank, inspection chambers and drain pipes. Figure 8 shows nitrocellulose loading into certified transport containers.

(a)

(b)

(c)

Figure 6. View of the production area: (a) open tank containing nitrocellulose before commencing works; (b) tank after tree felling; (c) tank cleaning, nitrocellulose rinsed with water, staff wearing anti-static clothing and using non-sparking tools

(a)

(b)

(c)

Figure 7. View of the production area: (a) inspection chamber containing nitrocellulose – material removal process; (b) drain pipe containing explosive sediments; (c) charge removed from the drain pipe formed by nitrocellulose deposits inside the pipe

(a)

(b)

Figure 8. Placing the extracted nitrocellulose after immersing it in water into an internal bag (a) water-proof, anti-static protecting the content placed into cardboard drums, (b) transport containers as required by the agreement concerning the International Carriage of Dangerous Goods by Road (ADR)

As a final stage of hazardous substance removal, the surrounding area was checked for nitrocellulose and other substances. The inspection showed that nitrocellulose was present in every single dip and ditch, and almost all mounds consisted of nitrocellulose, not soil. The inspections found railway tracks along the ditches, on which wagons carried non-conforming batches of nitrocellulose for disposal. Samples were taken at 45 different locations at different depths and analysed using differential scanning calorimetry (DSC) and Fourier-transform infrared spectroscopy (FTIR). The analysis showed high nitrocellulose content. It was estimated that approximately 670 tonnes of nitrocellulose must be extracted and disposed of. Due to the amount of explosives stored around the plant, the removal period was estimated at 2 to 3 years.

As it turned out in 2016, in the area handed over by the Municipal Council to the MESKO branch in Pionki, there is an undisclosed, overgrown former trinitrotoluene melting plant. A vat with 335 kg of trinitrotoluene was found at the location. An on-site visit carried out this year showed pieces of trinitrotoluene and tetralite under the leaf litter. Figure 9 shows the location of the melting plant and the remaining explosives.

(a)

(b)

Figure 9. Trinitrotoluene melting plant (a) and the remaining explosives found near the melting plant (b); the physical and chemical analysis showed trinitrotoluene removed from the shells

4. Summary

The two examples show different approaches to cessation of special production in chemical plants. The example of the Pronit plant in Pionki shows the tragic effects of the day to day cessation of explosive production and leaving the production department without securing and decontaminating the area, due to the lack of resources. Failure to disclose information on the leftover explosives and claiming that the equipment, facilities and the surrounding area were decontaminated and all the explosives were removed, was a reprehensible act by the management [3, 4].

On 2 March 2017, at the NITROERG chemical plant, Krupski Młyn branch, a man died and two other men were injured as a result of micro explosion. They were carrying out repairs of the production facilities which included removal of the floor. This is yet another example showing how important it is to maintain caution and use all means available to safeguard any works carried out in former special production facilities [5].

References

[1] http//pionki24.pl/aktualnosci/2449/rozbiorka-za-30-tysiecy... (in Polish) [retrieved May 11, **2011**].
[2] http://www.nadzagozdzonka.pl/wiadomości/3-newsflash/3149-nie-szukajciesmierci.html (in Polish) [retrieved Sept. 30, **2013**].
[3] http://www.pulshr.pl/prawo-pracy/prokuratura-przeslucha-bylych-pracownikow-pronitu,33344.html (in Polish) [retrieved Dec. 15, **2017**].
[4] http://www.polsatnews.pl/wiadomosc/2017-03-15/przedluzono-sledztwo-ws-niebezpiecznej-nitrocelulozy-w-pionkach/ (in Polish) [retrieved March 15, **2017**].
[5] http://www.dziennikzachodni.pl/wiadomosci/tarnowskie-gory/a/wypadek-w-zakladzie-nitroerg-w-krupskim-mlynie-w-wybuchu-zginal-mezczyzna,11844733 (in Polish) [retrieved March 3, **2017**].

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