

HAWKS NEST DISASTER

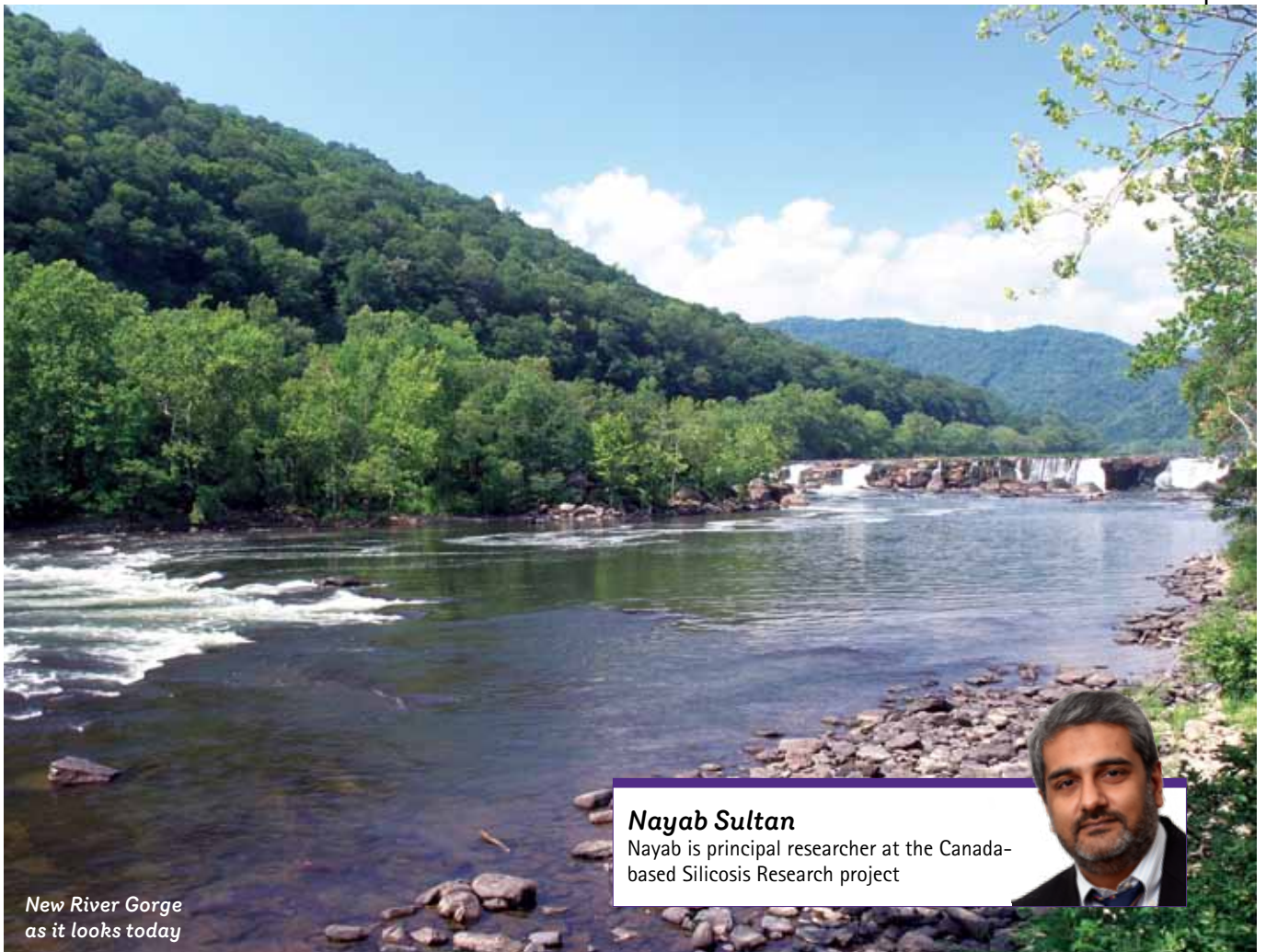
Nayab Sultan, Doctoral researcher at *Silicosis Research* gives this insight into the Hawks Nest Incident, considered by some to be the worst industrial disaster in US history

IN THE LAST 200 years we have seen some extraordinary engineering achievements that have pushed the envelope of engineering excellence to new heights. These range from the building of the Panama Canal, Karakoram Highway to a raft of tunnels and bridges across the globe.

Along with such advances there have been consequences of untold human life loss and suffering amongst the often transient migrant workforces that contributed towards these projects quite often with their life or health. One project that has been consigned to infamy is the construction of the Hawks Nest Tunnel by Union Carbide Chemicals Corporation in the US in the 1930s.

Considered one of the worst industrial disasters recorded in recent history this relates to a three-mile (4.8km) stretch of 30ft (9.1m) diameter tunnel used to divert a section of the New River downstream through Gauley Mountain in Gauley Bridge - a scenic cliff in the New River Gorge, in West Virginia.

Drilling through three miles of solid rock, the Hawks Nest Tunnel was viewed



*New River Gorge
as it looks today*

Nayab Sultan

Nayab is principal researcher at the Canada-based Silicosis Research project



Timeline

- 1930** - Construction begins
- 1930** - Workers start to get acute silicosis
- 1933** - Great trial starts against contractors
- 1934** - Another great trial starts against contractors
- 1936** - Union Carbide starts using power from tunnel
- 1936** - Hearings in US House of Representatives attribute 476 deaths
- 1986** - Study by Cherniack estimates 764 deaths due to silicosis from construction works

as a business-critical requirement for the Union Carbide's plant, located nearby in the town called Alloy for the purpose of steel alloy production.

AVOIDING RED TAPE

The tunnel was constructed to serve as a hydroelectric water diversion tunnel. At the time of the conception of the project the US was in the midst of a major economic crisis known as the Great Depression, as a result there was a great impetus to keep the wheels of the economy turning. Men desperate for work flocked to the area, the majority being African Americans from the southern states. Due to commercial pressures to finish in record time and fearing interference from the federal authorities and influence of powerful industrialists, the job was licensed as a civil engineering project, which meant it became exempt from the already lax

working conditions, and workers' health and safety legislative requirements such as wet drilling in mines and tunnels at the time.

In order to undertake the works, contractors were selected by Union Carbide. One of the two was a corporate entity created solely by Union Carbide for the works - New Kanawha Power Company - and Rinehart & Dennis of Charlottesville, Virginia.

During the initial scoping of works, core samples taken showed that the majority of the tunnel would be dug through a particularly high grade of silica bearing sandstone. This would later go on to become extracted by enlargement of the tunnel by a third even though Union Carbide claimed they were unaware of the presence of silica also known as silicon dioxide.

At its height of construction, between 1933 - 1934, an estimated 5,000 workers were involved in a range of activities on site. The vast majority of the black workers were tasked to do the dangerous jobs including working at the drilling face, with a small community of locals working in ancillary tasks. The combination of large work crews drilling and blasting underground in confined spaces, lack of dust suppression, presence of gas fumes, inadequate ventilation and no personal respiratory equipment were all significant contributory factors of high levels of exposure. It is thought that within two years of the initial groundbreaking in April 1930 that workers started to succumb to the effects of an incurable disease of the lungs - acute silicosis.

In all, an approximate 2,982 men worked underground in drilling and blasting, the majority of who worked 10-hour shifts six days a week. At any one time an estimated 500 men were underground with 35 at the drilling face. Of these 40 per cent worked more than two months and only 20 per cent more than six months. This was due to an astonishingly high percentage of workers inhaling large quantities of dust particularly silica dioxide.

Black workers were segregated and tasked to do more dangerous work than their white counterparts. Accounts from the time showed that the working conditions were considered atrocious with great risk to workers from multiple hazards including poor ventilation and gas fumes filling the worksite. Dust made visibility challenging and the lack of clean unpolluted air coupled with strenuous work meant workers would have to inhale more deeply thus taking in more inorganic dusts, including silica dust, deep into their lungs resulting in breathlessness, cough, fever and cyanosis (bluish skin).

VILLAGE OF DEATH

Local armed henchmen under the control of the Sheriff forced workers from their camp above the mountain entrance known as the 'Village of Death' and forced them out of bed to work at gun point according to one Congressional Hearing eyewitness. This witness spoke of fear and intimidation faced by many and those who were too sick to work were forcibly evicted from the site even when they could hardly walk. This was also the same fate that awaited those who started to manifest any of the typical symptoms of sickness. The transient nature of the workforce made it difficult to determine accurately exposure and consequences as many would either leave after becoming sick, be pushed out of town or simply die. Even with such harsh working conditions the tunnel broke through within 17.5 months, 10 weeks ahead of schedule, in September 1931.

Although the exact number of deaths is difficult to gauge, some light was shed on this by research conducted by epidemiologist Martin Cherniack in 1986, which showed the approximate figure to be 764 (581 being African American workers) from Acute Silicosis and associated conditions - a marked difference to the official count 476 presented to the US House of Representatives in 1936. This only became a political issue after national news stories were run for several weeks describing the plight of the workers. At this stage their conditions and unfolding tragedy became public

Table 1.

Type of Material	Crystalline Silica Found (%)
Tripoli	95+%
Sandstone	70 - 90%
Foundry Moulding Sand	Up to 90%
Plastic Composites*	19 - 90%
Road Rock	Up to 80%
Concrete / Mortar	25 - 70%
Shale	40 - 60%
China Stone	Up to 50%
Granite	20 - 45%
Tile	30 - 45%
Slate	20 - 40%
Clay	Up to 40%
Brick	Up to 30%
Ironstone	Up to 15%
Basalt / Dolerite	Up to 15%
Limestone	Up to 2%
Marble	Up to 2%

Source: Author

* silica used in composite materials or fillers

Table 2.

Type of Silicosis	Exposure	Latency before symptoms develop
Acute Silicosis*	Heavy exposure over short periods	2 weeks – 5 yrs.
Accelerated Silicosis**	High exposure over a period of time	5 – 10 yrs.
Chronic Simple Silicosis	Relatively low to moderate exposure over a long period of time	10+ yrs.

Source: Author

*acute silicosis was the primary form recognised in Hawks Nest but either of the other two forms could also have been possible.

**complicated silicosis associated with accelerated silicosis occurs as a result of severe scarring and can be complicated by other lung diseases such as TB, fungal infections and certain autoimmune diseases

knowledge. The numbers could have been far higher, possibly in the thousands, however with many workers leaving the county and the state after becoming sick or completion of their specified work it was difficult to gauge. Suggestions of mass burials could not be substantiated although many were buried in unmarked graves near the mouth of the tunnel. It should also be noted that it was also not unreasonable for workers with symptoms related to silica dust exposure to be misdiagnosed with other respiratory conditions.

Based on Cherniack's research there were 135 more deaths of white people in Fayette County between 1931-1937 compared to other neighbouring counties in the state of West Virginia. He was able to attribute these deaths to the tunnel and calculated that 63 per cent of local white men who worked in the tunnel for more than two months died within six years of acute silicosis.

One unnamed worker stated the reality is a harsh contrast: "men die in the camps, under rocks and everywhere else".

THREAT ANTICIPATION

Union Carbide continued to deny any knowledge or wrong doing claiming they were unaware of the presence of adverse working conditions and that the tunnel had not contributed to disease and death. In one statement by the chief engineer he claimed that he never saw dust or at least enough to say that it

was dusty. The corporate line remained that the threat of silicosis could not have been anticipated even though it was a recognised occupational hazard during that period. The companies claim was classed as duplicitous by Cherniack who stated they were fully aware of the conditions and in fact used the silica they removed and that it was common knowledge in the 1930s at the time that silica dust could be adequately controlled with adequate ventilation and moisture at the drill site. To further close the argument on lack of awareness the company provided its own engineering staff at the site with respiratory protective equipment.

After a high degree of controversy across the two high profile trials (1933, Fayetteville and 1934, Charleston) 538 claims were filed against the two contractors, however with evidence of jury tampering, political interference and generous compensation made to plaintiffs' attorneys the settlement came to a scanty USD 200,000 with individual awards of compensation ranging from a meagre USD 30 to USD 1,600. The controversy of the Hawks Nest Disaster was quickly forgotten by the press in fear and danger of stepping on the toes of powerful industrialists, according to senator Holt of West Virginia who had become a staunch advocate for action to curb silicosis deaths at the site.

Assigned to infamy the Hawks Nest Tunnel Disaster is now, as it was back in the 1930s, an important labour culture benchmark alongside Delamar, Nevada, also known as 'Ghost Town', which went on to be known as the 'widow maker' due to quartzite causing silicosis amongst its transient miners in the later 1800s.

The tunnel continues to operate and provide power to the current owners of the plant in Alloy, West Virginia.

CHANGE ON THE HORIZON

The Obama Administration has finally introduced stricter controls in the form of the 'Silica Rule' as a result of decades of political wrangling. OSHA states that the consequences of exposure have been known for millennia and that the new rules will protect approximately 2.3 million workers exposed in the US from harmful levels of airborne silica dust and the net savings of USD 3.8bn – USD 7.7bn, which in times of fiscal austerity will present huge benefits to the national economy.

What this means in terms of industry requirements is what was known even at the time of the Hawks Nest Disaster – using wetting techniques to suppress dust, capturing dust with vacuums or other dust capturing devices, and not

Hazard and precautionary statements

GHS Hazard Statements

H350: May cause cancer [Danger Carcinogenicity - Category 1A, 1B]

H370: Causes damage to organs [Danger Specific target organ toxicity, single exposure - Category 1]

H372: Causes damage to organs through prolonged or repeated exposure [Danger Specific target organ toxicity, repeated exposure - Category 1]

Precautionary Statements

P201: Obtain special instructions before use

P202: Do not handle until all safety precautions have been read and understood

P260: Do not breathe dust/ fume/ gas/ mist/ vapours/ spray

P264: Wash thoroughly after handling

P270: Do not eat, drink or smoke when using this product

P281: Use personal protective equipment as required

P307+P311: IF exposed: call a POISON CENTER or doctor/physician

P308+P313: IF exposed or concerned: Get medical advice/attention

P314: Get medical advice/attention if you feel unwell

P321: Specific treatment (see label)

P405: Store locked up

P501: Dispose of contents/container to ...

to place dependence upon the use of respiratory protective equipment, which may not be sufficient as a singular control measure, according to OSHA. The Silica Rule will be phased in during 2017 even though according to the Centers of Disease Control (CDC) silicosis is relatively rare in the US even though this remains the world's most common occupational lung disease.

SILICA DUST AND SILICOSIS

In the Hawks Nest Disaster reference was made to Acute Silicosis and other diseases. But the questions are more basic than this starting with 'what is silica dust'.

Silica occurs in three forms: crystalline, microcrystalline (or cryptocrystalline) and amorphous (non-crystalline) and is from the Latin word Silex or flint.

In the case of crystalline silica there are seven further forms (polymorphs) depending upon the temperature of formation. The three main polymorphs are quartz, cristobalite and tridymite. It is estimated that quartz is the second most common mineral in the earth's crust after feldspar.

Silica is, as in the case of Hawks Nest was in the form Silicon Dioxide (another name of silica), a chemical compound that had been used in various applications for thousands of years. Silica is commonly found in nature as quartz and is a major constituent of sand as well as in stone, rocks and clay. When cutting or drilling the respirable crystalline silica dust becomes airborne and can be breathed in causing hundreds of thousands of deaths worldwide. It is found mostly in mining and purification of quartz and is a recognised human carcinogen. Agricola 'the father of mineralogy' from the 16th century writes about problems from dust inhalation in miners.

The mineral quartz, cristobalite and tridymite are crystalline forms of silicon dioxide with quartz is simply yellow sand and is found in most rocks but particularly in sandstone and granite. Not all forms of silicon dioxide are as harmful such as amorphous silica such as diatomaceous earth, which is not known to cause either silicosis or lung cancer based on current research.

Silica dust is harmful on inhalation but the size of the particles is important with larger particles generally being stopped in the nose or the upper airway. It is the finer smaller particles which can make their way down into the lower levels of the lungs where gaseous exchange takes place where it becomes hazardous to human health causing scarring and chemical changes after being deposited in the lungs. Unfortunately the body's natural defences

such as mucous and coughing prove to be relatively ineffective in expelling this foreign dust from the body.

In the case of Hawks Nest the particles were fine coupled with particularly high silica content sandstone, which can contain 70 – 90 per cent, which is one of the highest ranges of materials. Information is provided in Table 1 from HSE data provided through the No Time To Waste Campaign.

Silicosis a shortened name for Pneumonoultramicroscopic-silicovolcanoconiosis and also over history had names such as Miner's Phthisis, Grinder's Asthma, Potters' Rot and many occupational variances. It is also a type of Pneumoconiosis meaning it is a disease of the lungs due to inhalation of dust, resulting in inflammation, coughing, and fibrosis.

Table 2 gives a generalisation of the exposure and the period before symptoms may start to manifest:

In Hawks Nest the majority of references relate to those with Acute Silicosis, which can happen as we saw in a very short period of time, in some cases simply months. Research generally places the scale of about two to 18 months but in the case of Hawks Nest the exposure was significant.

With prolonged exposure over a period of time usually 10-15 years would lead to chronic form of Silicosis, which many could have had but were no longer available due to be the migratory nature of the workforce.

Silicosis is only one condition that can occur from exposure to respirable crystalline silica dust and the others could also have been present amongst the Hawks Nest workers other than solely Silicosis:

- Chronic Bronchitis
- Lung Cancer
- Pulmonary Fibrosis
- Rheumatoid Arthritis
- Scleroderma
- Systemic Lupus Erythematosus
- Autoimmune Antibodies (Positive ANA, Anti-DNA, RF, others)

And also possibly:

- Chronic Obstructive Pulmonary
- Oesophageal Cancer
- Glomerulonephritis
- Sarcoidosis
- Vasculitis
- Dermatomyositis
- Granulomatous Disease (Liver)
- Immune Suppression
- Mesothelioma

Below: Historical photo of the excavated tunnel



Table 3. Some other projects assigned to history for worker deaths

Project	Years / Period	Estimated deaths	Primary causes
Panama Canal, Central America	1880 – 1914	30,000 (*25,000)	Accidents and Tropical Diseases ^Yellow Fever and Malaria
White Sea-Baltic Sea Canal, Europe	1931 – 1933	12,000 – *25,000	Accidents
'Death Railway' Burma-Siam Railway, Asia	1942 – 1943	7,000 – *70,000	Tropical Diseases and Malnutrition
Karakoram Highway, Asia	1959 – 1978	892 Official Record	Rock fall / landslides
Aswan Dam, Africa	1960 – 1970	500 – *550	Lack of Safety Equipment
Hawks Nest Tunnel, America	1930 – 1934	476 – *1000+	Respirable Crystalline Silica Dust exposure causing Silicosis
Hoover Dam, America	1931 – 1935	96 Official Record	'Industrial Fatalities'
Los Angeles Aqueduct, America	1908 – 1913	43 Official Record	Accidents
New York City Third Water Tunnel	1970 – Present	24	Accidents
St. Gotthard Tunnel, Europe	1969 – 1980	19	Accidents

Source: Author

*various conflicting reports suggest higher numbers however each various widely depending upon official and unofficial sources based on discrepancies in reporting at the time

- Myelodysplastic Syndrome (pre-Leukaemia)
- Pancreatic Cancer

Based on the above known conditions associated with silica dust exposure it is possible there could have been far more many conditions and workers who suffered as a consequence of their exposure at Hawks Nest other than just acute silicosis.

As a disease it is possible to diagnose using patient history, chest x-rays and also ruling out other possible underlying illnesses that may display similar symptoms such as pulmonary oedema, pneumonia and TB (tuberculosis). It is interesting to note that the Hawks Nest disaster was some 85 years ago but the same misdiagnosis remains even now around the world. There is no known cure and some old myths such as inhaling aluminium dust have their own problems of exposure. The current options relate to alleviating the symptoms and avoiding complications.

Prevention is the best form of protection against silicosis and other illnesses by either complete elimination of the silica dust hazard or by introducing suitable engineering controls such as dust control strategies using dry air filtering and water spray where dust emanates. That said each worksite needs to have a comprehensive review of the hazards (risk assessed/ hazard analysis/field level hazard assessment/job safety analysis – whatever technique is used) and establish suitable and effective risk control measures such as development of an ECP – exposure control plan – coupled with a health surveillance program for all those exposed to respirable crystalline silica (RCS) dust based on local legislative requirements relating to workplace exposure limits/occupational exposure limits.

References


- Cherniack, Martin G. "Hawks Nest Tunnel Disaster." e-WV: The West Virginia Encyclopaedia. 04 June 2015. Web 13 April 2016
- Allan M. Brandt (1989). Review of Exploring the Dangerous Trades. Reviews in American History 17(1):101-107
- GBD 2013 Mortality and Causes of Death, Collaborators (17 December 2014). "Global, regional, and national age-sex specific all-cause and cause-specific mortality for 240 causes of death, 1990-2013: a systematic analysis for the Global Burden of Disease Study 2013" Lancet 385: 117-71

OTHER LOSS OF LIFE

It is interesting to note that Union Carbide through the Union Carbide India Limited (UCIL) also ran the site in Bhopal in which Methylisocyanate (MIC) was accidentally leaked from the plant and the gas made its way down into the adjoining shanty resulting in an estimated 5,200 deaths and thousands exposed to life changing disabilities.

With all the technological advancements made many large scale projects still under construction continue to have a number of fatalities, which continues to rise even with advances in knowledge and technology.

Even with silica dust being known to be harmful to human health for many centuries and history showing a litany of disasters the menace of silica dust and threat of silicosis continues to loom over workers. With current estimates of workers exposed ranging from 500,000 in the UK, 5 million in the EU, 2.2 million in the US, 10 million in India and an astounding 23 million in China. In terms of deaths this is in an estimated range of 800 in the UK from lung cancer, with 7,000 cases of lung cancer across the EU due to silica dust.

It is important to remember that silica dust can be controlled and silicosis can be avoided, yet even in 2013 there was an estimated 46,000 deaths worldwide from this totally preventable disease which continues to cause terrible suffering globally to millions 

Useful links

- www.silicosisresearch.ca
www.silicahazard.com