SULLIVAN MINE ACCIDENT - Speaker Notes

Presented by R. Berdusco to the BC MEND ML/ARD Workshop
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The week of May 15, 2006 marked a tragic sequence of events which cast a cloud over a mine with a long and proud history of underground mining in the East Kootenay region of the Province. It was a week when 4 people lost their lives to an oxygen-depleted atmosphere in a water sampling shed at the Sullivan mine site.

The Sullivan mine had ceased mining operations in 2001 and was engaged in reclamation activities since that time.

The mine had dismantled the surface structures no longer required on the site; had covered and sealed mine and ventilation openings no longer necessary; covered several of the tailings impoundments which had been sources of water contamination and had established a water treatment facility which would treat water pumped from the flooding underground mine and from collection points established over the property. Sampling of effluent from the mine had been conducted as part of the monitoring program during operations and this was continuing as part of the closure sampling and monitoring program. Remaining field work included resloping of mine dumps, revegetating areas of the property, and logging areas which had been damaged by Pine Beetle infestations.

The activities which resulted in the tragedy were associated with the resloping and revegetating of the #1 shaft waste dump and the associated water collection and sampling of the seepage from that dump.

The dump had been constructed over a period of some 60 + years beginning in the 1940's when the #1 shaft was developed. Substantial dumping activity had also occurred in 1980/81 with the development of mechanized mining and the ramp access associated with that. The dump prior to reclamation is shown in slide 2. This photo illustrates the dump in 2004. The dimensions of the dump are approximately 1000m x 500m. It is estimated that the dump mass is approximately 2.9 million tonnes with a volume of about 1 million m^3. About 1/3 of this volume is estimated to be void space. A ditch was constructed at the base of the dump in 1993 to collect water draining from the dump area and direct this water for monitoring and treatment. The original ditch was a simple slot cut into impermeable till which formed much of the dump foundation. Two arms of the ditch were graded to a central collection point where , at the confluence, water flows were measured and samples obtained. This collection site was below ground level and, due to the climate in the Kimberley area, was susceptible to freezing. In 2002 a shed was placed over the site to protect it from the elements as well as for security reasons (tampering from trespassers) and remained there until the present.

In 2004 major work commenced on this dump and entailed construction of a larger collection ditch followed by resloping of the dump. The ditch which was constructed had a large cross-section (15 m^2) and so the capacity of the ditch with a 1000m total length was about 15,000 m^3. The ditch was excavated and later filled with coarse rock so as to create a high capacity coarse drain. The dimensions and scale of the ditch are seen in slides 3 and 4 below. The shed can also be seen in slide 3. Resloping of the dump was completed in the third quarter of 2004 and can be seen in slide 5. Also visible in the slide is the location of the shed over the sampling site. (show shed). The final phase of the project was placement of a till cover approximately 1 m thick to be followed by grass seeding. This till cover was placed in the summer of 2005 and was completed in the 4th quarter of that year. A cross-section of the resloped dump, the cover, the seepage collection pipe and shed are shown in slide 6. Everyone here is very familiar, I'm sure, with the oxidation process which occurs in metalliferous mines with associated sulphides and I've included a slide (slide 7) to illustrate a basic oxidation formula involving pyrite. The result of this process is a reduction of oxygen within the atmosphere. Secondary to this process is the combination of the sulphate produced with hydrogen to produce an acid (sulphuric acid) which combines with available calcite as illustrated in the bottom formula in the slide. This secondary reaction, as you can see, releases carbon dioxide. Water infiltrating into the dump provides the hydrogen for this reaction.

The resultant atmosphere produced will, over time, be deficient in oxygen and enriched with carbon dioxide and nitrogen. This is reflective of the atmosphere which was sampled within the shed during the course of the investigation and is illustrated in slide 9.(slide 9).

The till cover was designed and constructed to minimize the chemical process described above. Till is high in clay content and so is fairly impervious to moisture penetration. This would act like a water resistant skin to shed precipitation and minimize infiltration of water into the dump. It also inhibits air ingress into the dump. Both of these functions minimize the chemical reactions described in the earlier slides. The last function of this till cover is that of a growth medium.

The end result of the work performed on the #1 shaft waste dump was similar to reclamation work performed on similar dumps on the Sullivan property. However, this work was done more completely and, from an ARD control perspective, better on this dump. The ditch was deeper and larger in cross-section; the cover was thick and impermeable and <u>extended completely to original ground, completely sealing the dump</u>. The only place where the contents and seepage from the dump could exit was at the discharge pipe located at the shed.

Unforeseen was the potential that this discharge pipe and the constructed drain would act as a conduit for not only the water seeping from the structure but also for the atmosphere within the dump.

The phenomenon experienced in the discharge of oxygen-depleted and CO_2-enriched air from this dump was unprecedented on this property. No indications of foul air had been reported or otherwise observed in similar circumstances elsewhere on the property. Theories as to why this dump is different from the others have been brought forward and testing is underway to determine the mechanism of mobilization of the gas as well as to try and arrive at design that prevents the discharge of this type of atmosphere. Sample results have been obtained and are being reviewed by a group of professionals to confirm the mechanism of mobilization and recommend remedial action.

Meanwhile, protective measures have been put in place which will prevent exposure to potential discharge points and/or accumulation points for this type of atmosphere.

The realization, however, that this type of design feature and the objectives of this type of activity….specifically reclamation and ARD control…..could create this type of a hazard has been a sobering experience. Reservoirs of potentially hazardous atmospheres may be created and can be mobilized. Once the mechanism of mobilization is fully understood design changes which will incorporate not only control of ARD generation but elimination of any hazards associated with the control will be established and enforced to prevent any reoccurrence of this event. This, I anticipate, will take place in 2007.

Thank you.
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Chief Inspector of Mines

For More Information:
http://www.mediaroom.gov.bc.ca/sullivan_mine/sullivan_mine.htm