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Jagersfontein Dam Collapse

VS 14.09.2022

A few years ago, a series of losses affecting tailings storage systems (TSFs), caused a stir in the mining industry and in the (re)insurance industry. Those who are familiarized with the matter, will remember the cases of Cananea (Mexico 08/2014), the Mariana dam (Brazil 11/2015) and Brumadinho (Brazil 01/2019). These events - highly publicized - have triggered a wave of inspections and technical reviews of these structures. The recent collapse of a tailings dam slope in South Africa, reminds us that we cannot lower the guard regarding a continuous and updated surveillance of the conditions of these structures.

Background to the new event:

Jagersfountein is a mining town in the Free State province of South Africa. Its mine is known to have yielded a diamond harvest of extraordinary dimensions in the last century. De Beers - the world's largest diamond producer - owned the mine until a few years ago, after which there have been several changes of ownership in various non-transparent financial transactions.

The mine has a TSF, where tailings reprocessing wastes from previous beneficiation operations were deposited. It is common in mining operations to reprocess tailing left-over of previous operations, with ever more modern techniques to optimize the extraction of minerals to the maximum.

The Jagersfountein TSF had considerable dimensions, as can be seen from the google earth image:

The Jagersfontein TSF as per February 2021

A google earth measurement of the TSF shows a rectangle with a length of 1 kilometer and a width of approximately 450 meters.

On September 11th, 2022, at 6:30 am a collapse was recorded in the southeast sector of the dam causing an avalanche of mud and water that partially affected the below-located mining town, causing severe damage to electrical infrastructure, water supply, telephone communication towers, as well as homes, livestock farms and an important communication route. Three deaths and 40 injuries were reported. The mud flood covered an area of about 7 kilometers and a width of up to 2 kilometers on relatively flat terrain.

The event was widely reported in the local press. We present one of the most representative publication:

REUTERS

UPDATE 1-South Africa mine dam wall collapses, killing 1 and injuring 40

Nqobile Dludla

Sun, September 11, 2022, 10:43 AM·2 min read

JOHANNESBURG, Sept 11 (Reuters) - Flooding caused by the collapse of a mine dam wall in South Africa's Free State province swept away houses and cars on Sunday, the provincial government said, killing one person and injuring another 40.

The disaster occurred in the diamond mining town of Jagersfontein at around 6:00 a.m. (0400 GMT), the government said, forcing officials to evacuate scores of residents to nearby farms.

One person was declared dead after their body was recovered, while 40 people, including one pregnant woman and four individuals with fractured limbs, have been taken to hospitals for treatment.

The government said in a statement that search and rescue efforts are continuing at the dormant diamond mine, which was once owned by De Beers, a unit of Anglo American.

"A detailed report on the circumstances surrounding the incident will be released upon compilation," the office of the Free State Premier said.

Minister of Mineral Resources and Energy Gwede Mantashe told reporters that nine houses were swept away while 20 were completely damaged by flooding from the tailing dam.

"Compensation for fatalities, compensation in terms of damage to property will be taken as a responsibility of the company that owns the slimes dam," he said.

State-owned power utility Eskom said in a separate statement it lost bulk electricity supply in the area when its Rietkuil substation was engulfed by mud and aims to restore supply to the Jagersfontein mine before the end of the day.

"It is impossible to estimate when supply will be restored or to determine the extent of the damage," Eskom said.

The flooding damaged cellphone towers, hitting communications, and affected drinking water, while some roads were cut off. Many sheep have also been washed away, non-governmental organization, Gift of the Givers said.

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Mobile operator Vodacom told Reuters that two of its impacted base station sites are now back online after deploying generators to power them, while rival MTN said it is looking for an alternative way to access a tower it shares with others in order to restore power and services.

The Minerals Council industry body said it had reached out to authorities to offer whatever practical support and assistance that the industry can provide.

De Beers said at the time of the sale of the Jagersfontein mine and tailings in 2010 to Superkolong Consortium, which comprised of black investors, that it had produced some of the world's largest gems when operating between 1870 and 1971. (Additional reporting by Wendell Roelf; Editing by Alexander Smith and Raissa Kasolowsky)

The following images are from different newspapers and/or YouTube video clips:

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A saturated embankment can be observed

The flooding crossed an important highway

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A grey sludge covers roads in Jagersfontein after a mining dam burst on 11 September 2022. Picture: @NationalCoGTA/Twitter

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Our Analysis

As usual, in an effort to take pedagogical advantage of this type of events, we at RISC tried to analyze this case based on our experience related to the mining industry, also taking into account critically the initial information about the event at hand.

1. In the first instance, in the google earth image - the latest available image is from February 21 - we observed an extremely watery dam which has also led us to measure the height of the free board. To our surprise - and aware that only digital photogrammetry can give us a more precise measurement than the generic google earth ones - we noticed that the free board is non-existent in several sections of the perimeter of the containment. In short, in some stretches the level of the deposit, saturated with water, appears to reach the level of the dam's crown. If this circumstance corresponds to reality, we are facing an enormous and unacceptable risk aggravation.

2. Google earth allows us to view images from previous years. We have viewed images from 2017 and 2019 of the same area of the TSF and we can see that the base of the southeast slope of the dam has been reinforced, that is, exactly at the point where the structure failed.

Image 8/2017

Image 5/2019

Image 2/2021

The images indicate that there may have been a history of weakness in the area that has now collapsed.

3. In the first image we can also observe an accumulation of water at the base of the slope, which may be the result of over-topping or, more likely, seepage, which was then controlled by widening the slope. If this was the case, the measure would be highly questionable, since seepage is not controlled by simply adding thickness to the structure. This aspect alone indicates the complexity of a TSF (Tailing Storage Facility), which requires detailed attention from its design and construction: site preparation, up-lifting, use of suitable material and its treatment for the slopes, as well as a well-defined strategy for the up-lifting of the boards and/or containment slopes.

4. The operation of the TSF itself requires a detailed program of tailings disposal into the deposit area, control of the solids-to-liquids ratio as well as monitoring of wet areas. Slope angles must be monitored; berm maintenance, crown conditions and freeboard height require continuous attention &

maintenance. Ideally, the tailings dam's operation is managed by personnel specifically appointed for this duty.

5. Once the life cycle of a tailings impoundment ends, i.e., when it reaches its maximum filling capacity, it is closed and a new reservoir area is started. It is important that the closed reservoirs continue to be monitored. Settlements, the appearance of furrows, washouts on the slopes, and/or landslides may occur. Intense and persistent rainfall can often change the consistency of the filling and saturate the containment structure. In extreme cases, dam collapses occur, such as the one that occurred in Jagersfontein.

6. It is very important to pay attention to weather conditions in the mining region. Evaporation factors and rainfall are important parameters to consider. Public comments, after the Jagersfontein event, indicate that the region had been affected by a persistent rainfall in recent months. Based on our experience, we can confirm that an intense rainy season has a very important influence on the solids/liquids ratio of the reservoir and on the distribution of the wetted area in the containment. It is of paramount importance to monitor the containing structures and to have all the instrumentation available to detect any variation of the TSF`s stability parameters. Shear stresses in the slope of the containment structure must be monitored in detail. Control wells, piezometers, inclinometers, are elements that should not be missing in a TSF. Only experts in the field can make evaluations and recommendations in this regard.

7. Procedures and guidelines have long been developed specifically for the construction, operation and closure of tailings dams. Following the spectacular events in Brazil and others in Australia, mining industry associations have reviewed and updated these standards. One aspect that is mentioned in many updated procedures of different institutions (government, mining companies, mining guilds, risk managers) is the review of the design and operation of the TSF by an independent third party expert. Another aspect on which much emphasis is placed is the contingency plan or response to a failure of the dam berms or retaining walls. This includes detailed studies on the weak points of the structure and the downstream areas that may be affected in the event of a spill. With respect to structural integrity studies of the TSF - these should be performed routinely - it is important that they are performed by independent engineers / parties with the appropriate expertise.

Conclusions

The mining industry is a highly complex business. Tailings dams are just one component of this industry, exposed to risks that can lead to catastrophic losses. Focusing on tailings dams, it is clear that continuous and independent monitoring of their conditions is required. From our perspective - with the tools at hand today and following international standards of good practice - TSF slope collapses should no longer occur. In this sense, the Jagersfontein event in South Africa is a wake-up call and a reminder of the exposure the insurance industry faces.

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Appropriate measuring equipment, continuous monitoring of slope movements, routine inspections, observation and evaluation of the intensification of meteorological phenomena (precipitation), are aspects that cannot be left aside.

Considering that the collapse of the containment structure of a tailings dam does not only result in material and consequential damages in the term of an All Risks policy, but also in liability and environmental damage, the underwriting of this type of risk becomes a highly responsible task. We confess that we are surprised - in view of the ESG concept prevalent for years already in the (re)insurance industry - that more incisive and robust measures have not yet been taken with regard to the conditions for the insurance of tailings dams - or tailings storage facilities. Routine inspections, carried out by engineers trained in this type of risk, are an integral part of the control measures that must be taken to avoid foreseeable losses.

Links:

https://www.youtube.com/watch?v=KwvCrvBB2RU

https://tailings.info/knowledge/guidelines.htm

Red. V. Stewens
Miami 20.09.2022