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TAILINGS DAM FAILURE RESEARCH

Tailings Dam Failure Research

by Dave Chambers

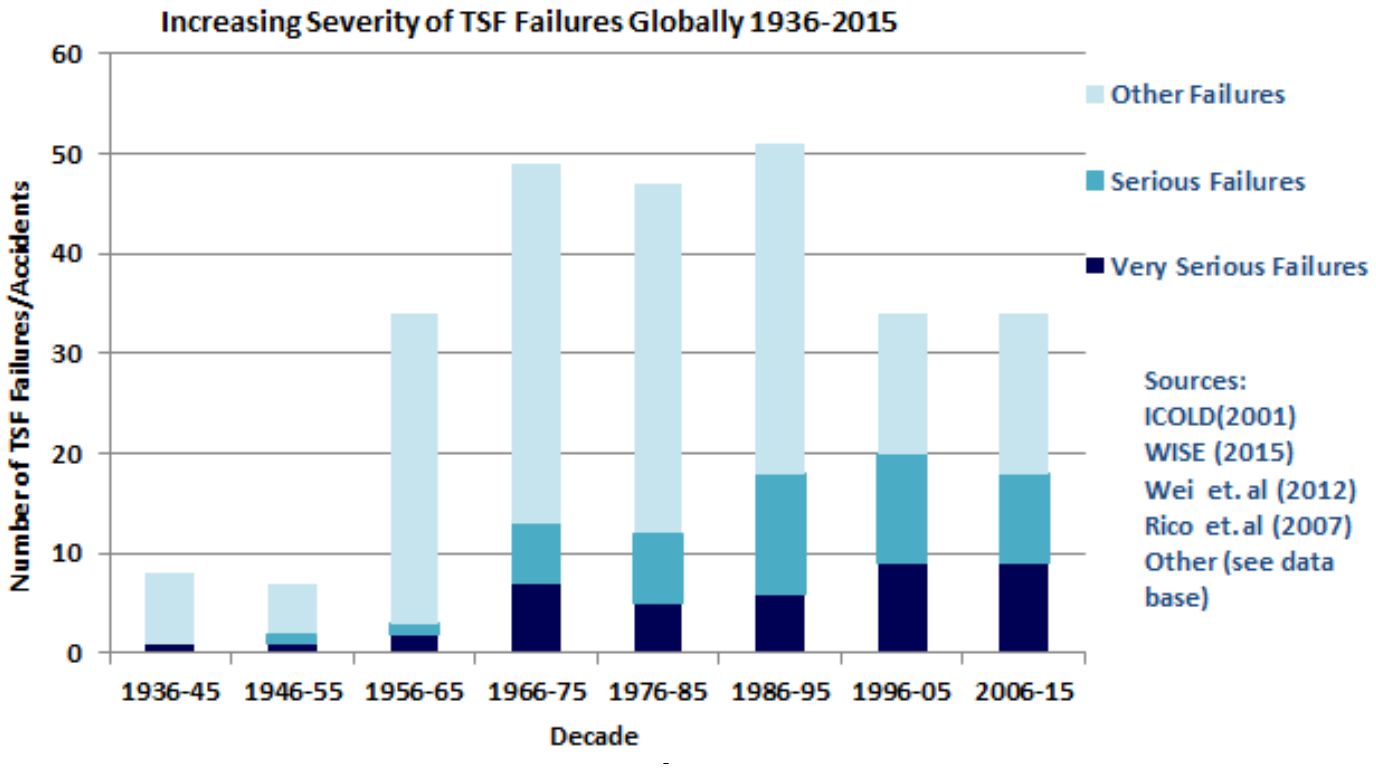
Over the past two years I have teamed with Lindsay Newland-Bowker, a risk analyst, to research tailings dam failures. This has led to several papers and a number of conference presentations. We got involved in this topic because we wanted to know if modern engineering, operational techniques, and regulation were leading to a decrease in tailings dam failures. Unfortunately, we could not find this in the available literature. What we did find was disturbing on several levels. No one knows how many tailings dams have failed, or even how many operating tailings dams there are. This information may exist somewhere in a government file, perhaps in British Columbia and Nevada, but it does not exist at any national or the international level. This is alarming because tailings dam failures can cause billions of dollars in damage, as a recent failure in Brazil had demonstrated, but no national (e.g. the USEPA) or international body (e.g. the International Commission on Large Dams, or the United Nations Environmental Programme) deems in necessary to determine how this is happening, and how to prevent it.

Fundao Tailings Dam Failure, Brazil, November 2016

Mt Polley Tailings Dam Failure, British Columbia, August 2014

Tailings dams fail at rate ten times that of water supply reservoir dams. There is no engineering reason for this. But because tailings dams are constructed differently than water supply dams, and because cost, not safety, is the primary consideration for tailings dams, tailings dams fail more often.

As a result of our research, we now have the most complete publically available database of tailings dam failures, which is posted on the CSP2 website. We are not aware of any better data sources, although they could exist in the private sector. Our database is comprised of information available on the web. CSP2 does not have the resources to get data from regional regulators, if they have it and will release it, but someone should compile this information. Regulators may not want to release, or even collect, this information because it essentially documents regulatory failures. Nonetheless, without this information



This figure shows that the total number of tailings dam failures is decreasing in recent decades, while the number of Serious and Very Serious failures are increasing.

we cannot effectively move toward a solution to these failures.

No regulatory regime requires a financial surety or insurance for a catastrophic tailings dam failure. Present financial surety requirements cover only reclamation and water treatment. Lindsay and I wanted to know if requiring such insurance was feasible, and if there was a parameter that could be identified that could be used to predict the number of potential failures for insurance purposes. What our research showed was that the number of catastrophic tailings dam failures was increasing, not decreasing, and that copper production correlated very well with number of catastrophic dam failures and could be used as a predictor for risk-analysis purposes.

In addition to showing that the number of catastrophic failures was increasing, not decreasing due to better engineering, operating practices, and regulation, but that in order to get the costs of such failures to an insurable level the number of tailings dam failures needs to decrease to the level of water supply dam failures. This is obviously possible from an engineering perspective, but will require significant changes in tailings dam design and operation to make this happen.

In August of 2014 the tailings dam at the Mt Polley copper mine in British Columbia failed catastrophically. The Province of British Columbia convened and expert panel of tailings dam engineers to analyze the failure, and to make recommendations on how to prevent future failures. The recommendations of the Mt Polley Expert Panel are enlightening. Among the Expert Panel recommendations is that:

"Improving technology to ensure against failures requires eliminating water both on and in the tailings: water on the surface, and water contained in the interparticle voids. ... Simply put, dam failures are reduced by reducing the number of dams that can fail." (Mt Polley Panel Report, Jan15)

In other words, water must be eliminated on and in the tailings because it increased both tailings instability, as well as the severity of the impacts if there is a failure of the tailings impoundment. What we are seeing in the way of regulatory changes in British Columbia as a result of the 2014 Mt Polley dam failure is that BC is depending largely on Independent Tailings Review Boards to inform design and operational practices, and that BC is still treating each dam design and impoundment management practice on the basis of site-specific considerations. This means that tailings impoundments are still being used for excess water storage, and water covers are still being used for

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the long-term storage of potentially acid generating waste. However, the regulatory changes made in BC will not be enough. The dam that failed at Fundao in Brazil did have an Independent Tailings Review Board.

Making tailings dams significantly safer will require several significant changes – changes that will cost mine operators more money, but which will result in greater public safety and less long-term liability to both the public and mine operators. "Eliminating water both on and in the tailings" is feasible and reasonable, but will require some more costly design and operating procedures. This means no water storage on the tailings, purporting that some other way of storing or disposing of this water must be found. This also means no wet closures for the prevention of acid generation. This will require better design to minimize the amount of water to be treated in perpetuity – but the Expert Panel clearly said that long term treatment is preferable to wet closure.

Tailings dam design also needs to make safety the primary consideration, also a recommendation of the Expert Panel. At present cost is the driving consideration, and safety is only a consideration. This is a major contributing factor to the rate of tailings dam failures being larger than that for water supply dams. Making safety the primary consideration in tailings dam design, operation, and closure will require leadership from regulatory entities. Mine operator X will not do it unless mine operator Y must also do so.

The need for major changes in business as usual in the mining industry are supported by our research on tailings dam failures. At present things are getting worse, not better. Lindsay and I plan on continuing this effort, but at present all of this work is being funded by CSP2 and Bowker Associates Science & Research in the Public Interest, both non-profits with no independent funding for the work – your support will be appreciated.

From the Executive Director

Dave Chambers is the Executive Director of CSP²

I'm an old Navy man (and I'm not referring to the clothing brand). I spent some time on very large ships – aircraft carriers. As the saying goes, it takes a long time from turning the wheel to actually changing the course of the ship. There's a lot of momentum behind a big ship.

The Mt Polley Expert Panel recommended some significant changes to the way tailings dams and impoundments need to be designed, constructed, operated, and closed. To quote: "*The Panel firmly rejects any notion that business as usual can continue*." Trying to get tailings dam designers, operators, and regulators to change 'business as usual' is like trying to change the course of a large ship with a lot of momentum. First of all, tailings dam designers have faith in existing design procedures, and believe that if recommended operating procedures are followed by responsible mine operators, in a modern regulatory environment, no failures will occur. This was clearly the attitude in British Columbia before the Mt Polley dam failure, but it was clearly disproved.

I believe there are two issues that are being ignored by designers, operators, regulators and that continue to facilitate 'business as usual.' First, engineers have a tendency to believe that they have learned all of the lessons to be learned. The Mt Polley failure clearly debunks that theory. Tailings dams need to be designed to stand in perpetuity, and to assume that after 50 years of rigorously researching tailings dam design we know enough to insure their stability in perpetuity is naive.

Second, engineers often neglect human nature. It is human to cut corners, to believe that after a few years of operational experience an operator has more insight to dam operation than a designer and can unilaterally change operating practices, or just that humans will make mistakes.

Tailings dams need to be designed and operated with multiple layers of safeguards that will minimize the opportunity for human intervention and error in dam design and operation. I believe this means doing away with upstream dam construction, which contains too many opportunities for design and operational errors; and, removing stormwater storage as an operational practice for tailings ponds, as recommended by the Mt Polley Expert Panel, since excess water drastically increases the impact of any dam failure. If these things don't happen, then it will be 'business as usual.'

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