Shell Oil's challenge in Canada

This involved constructing drilling platforms and haul roads in areas of water-laden muskeg (peat bog) often on top of clay with a CBR of <1%. The oil sands they worked were typically 40-60 meters deep. When the frozen ground thaws in the spring, the saturated water of the muskeg peat causes severe swelling and heaving of the drilling platforms and access road structures. With the return of winter five months later, the freezing of the high water tables buckles and distorts roads and all platform surfaces.

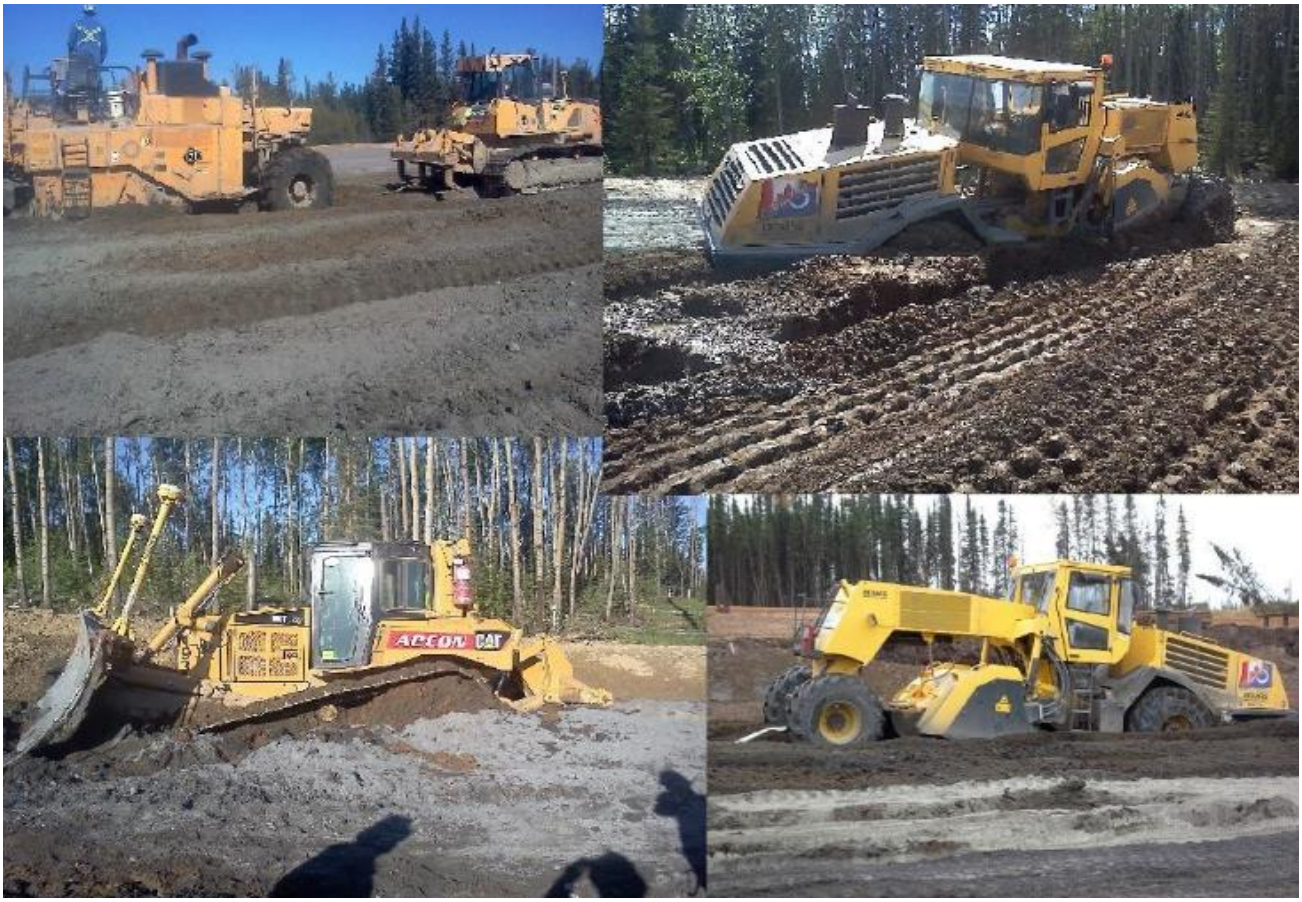
Shell needed to build new haul roads and drilling platforms. And the solution had to provide durable performance for extreme loading in the softest subgrade. Together with maintaining dimensional stability in -40°C temperatures.

The Solution

Standard construction of the drilling platforms often requires the complete removal of the soil and replacement with imported stone. If the muskeg is not completely cleared to bedrock, its high water content will cause buckling and distortion from winter freezing The access roads are usually "corduroy" large log and tree mulch waste infill. However, these cannot support heavy loads and /or sustained use and temporary wooden mats were used to create mattresses across the soft terrain; however these are best for only small areas – they are expensive, logistics are complicated and they are time-consuming to install.

After a number of successful commercial demonstration projects in 2007 and 2008, Shell began to adopt the PowerCem based solution RoadCem as an economical and far superior alternative to the standard clay-gravel-wood matting methods traditionally utilized. In 2009 PowerCem were given a final challenge to stabilize a pad encompassing 30,000 m^2 that would need to support a huge triple "walking" drill rig with a combined rig/pipe weight exceeding 1,000,000 lbs.

Thus both extreme static and dynamic loads would have to be successfully supported. RoadCem enhanced zeolite soil concrete on top of highly plastic clay soils with a high water table underneath. The gravel required was reduced by over 90%, better clays didn't have to be sourced, as in situ native soils proved sufficient and millions of $ worth of wood matting didn't have to be manufactured and placed. The final mix design was a RoadCem cement-PFA stabilized base of 400mm thickness with a small amount of road crush gravel for a friction/wear course. Construction time was significantly reduced and the benefit not only met the high load demand of the initial drilling cycle, the stabilized base provides years of trouble free access and a simple future reclamation. With oils and acids usually only penetrating the top 40mm of the RoadCem base, the top 15mm were ground off for disposal and the remaining 385mm simply milled back to soil and left on site for regrowth.



Over the first three years of providing RoadCem based soil concrete bases for Shell. PowerCem experienced results which appeared to disprove the traditional expectations. For example, sites with high water tables and consisting of frost susceptible silts did NOT suffer any frost damage even when subjected to multiple freeze/thaw cycles under heavy traffic.
And when carrying out late fall stabilizations, using RoadCem the soils often retained enough heat for hydration even when hit by cold snaps with day time temperatures below minus 10 Celsius.


Thank you Robin for your mail.
The Shell internal development release process on RoadCem has indeed just been formally completed with a positive outcome.
Unfortunately, this is a restricted report that we cannot share with people outside Shell and we cannot not give any product our full Shell approval statement, as the context in which this could be used would be outside our control.
It is well documented that both cement and flyash powder contain potentially toxic elements like arsenic, mercury, chromium 6, etc. When used correctly, exposure to and leaching of these toxic elements can be kept below known hazardous exposure levels. That is why Shell specified that RoadCem is used for ground works in sensitive environmentally protected areas like Canada's native Caribu lands, not just for strength gains but more importantly for the permanent molecular level encapsulation of all these toxic elements.
As our oil and gas exploration and extraction projects are subjected to independent environmental testing for the Canadian Government and even more intensively by local aboriginal authorities it is important that RoadCem soil cement doesn't leach nor exhibit any deleterious effects.
Traditional soil stabilisation with cement, lime or flyash in any combination without your PowerCem additives will have the potential to contaminate groundwater through leaching and migration of the toxic elements.
We will now actively search for deployments of RoadCem across the Shell organization. Equally if you see deployment opportunity in a Shell project, please contact Nishtha so we can coordinate efforts.

Kind regards,

Ewoud van Haaften CEng KIVI
CSO Technology and Capability lead

Shell