In for the long haul

Josh Swank explains the challenges of hauling oil-sands material, and how manufacturers are working to create a fleet engineered specifically for this industry.

Albert Einstein once said: “The important thing is not to stop questioning.” In the mining industry, a lack of inquisitiveness may lead to a blissful ignorance, but it certainly won’t increase efficiencies.

While one may claim that necessity is the mother of invention, questioning and analysing how methods and systems can be improved is the catalyst to discovering necessities. Understandably, when working in the middle of Canada’s oil sands, where trucks operate 24/7 365 days a year, it’s nearly impossible to pull the nose from the grindstone long enough to provide thorough analysis. However, fortunately some manufacturers have assisted by taking a long hard look at the process and ensuing headaches within this application.

Each day in oil-sands mines, like the Athabasca oil sands in Fort McMurray, Alberta, 1.5Mt of sand laden with thick, sticky bitumen is loaded into some of the biggest trucks ever made and transported to crushers for the oil extraction process. Time and again, massive shovels dump scoops of 100t of material into the unyielding truck beds. Loaded with 360t of material, the trucks then transport and dump the material for separation.

On the surface, it may appear that truck bodies don’t deviate much from one design to another, with their applications deviating even less. But take a moment to speak with an operator about his/her day and it’s easy to see that assertion couldn’t be further from the truth.

Spending some time with operators of mines in the oil sands will quickly reveal the necessity for dedicated oil-sands truck bodies designed from the floor up for the challenges specific to these mining operations. The new designs offer enhanced truck-body life – raising expectations beyond the meagre three-year average – enhanced performance and improved operator comfort. The result of this quest for answers is now at work in the Athabasca oil sands around Fort McMurray.

Philippi-Hagenbuch has engineered its High Performance, oil sands-specific truck-body design, which addresses the three major challenges inherent in oil-sands operations. First, the designs eliminate the “loaf” effect – that amalgamated and compacted 360t block of sand that releases in a single “loaf”, jarring the truck and operator. Second, it minimises the amount of carryback material, and ensures that most of the load is dumped the first time for greater efficiency. And finally, it enhances the life of the truck body well beyond the traditionally accepted three-year replacement point.

**SLICING THE LOAF**

It takes a little imagination to envisage 360t of sticky, oil-laden sand jostled and bumped around as it is hauled on access roads to a dumping point for processing. During that journey, the shaking and jolts result in a vibratory effect that compact the sands into a firm loaf. Much like brown sugar falls in a formed mass from a measuring cup, this sand releases in a solid block once the truck body lifts.

With a significant amount of load over the rear axle, the dumping motion often causes the front of the truck – which weighs almost 100t on its own – to lift up off the ground. As the loaf releases, the truck and its driver release from suspension and slam back into the ground. This repeated process stresses both the truck chassis and the drivers, who, over time, can suffer from back and neck issues caused by the repeated whole body vibration exerted on them.

High Performance oil-sands bodies feature several carefully engineered modifications to assist in slicing up that loaf of compacted sand. A unique bed design features severe tapering of the sides of the truck body (rather than the traditional parallel sides of standard truck bodies), which serve as a chute for the compacted loaf. Significantly tapered sides effectively increase the opening at the end of the truck bed by 10-20%. This increased width at the dumping point removes support from the sides of the loaf, as it is unloaded, allowing successive layers to crumble and drop away from the solid mass.

To initiate breakdown of the loaf further, the back third of the truck floor angles forward from a centre point in the floor to the sidewalls. This angling results in the sides of the truck body floor being significantly shorter than the centre, thus allowing the corners of the load to fall away before the centre of the load reaches the lip of the floor. This effectively removes support of the floor from the underside of the loaf edges, forcing it to break apart as it exits the truck body, exerting much less force on not only the truck chassis, but the driver as well.

The success of these adaptations for mining becomes clear at a glance. After a week running sand, traditional truck walls are polished to a shine from the abrasive load. But after a year of doing the same in a truck body specifically designed for the oil sands, paint remains on the sidewalks.

**CUTTING THE CARRYBACK**

Just as the oil sands adhere to one another, that same sticky property culminates in material sticking to the traditional truck-body floors and walls. This property is evident in a simple walk through the sands, which quickly deposits a build-up on the soles of the traveller’s shoes. Imagine what happens under the weight of a 360t load.

The resulting carryback lessens efficiency and often results in a compounding problem, as more and more material sticks and builds in trouble areas. In essence, the same load is carried again and again when it fails to release. More than 60t of carryback material can stay behind, significantly decreasing productivity. Alternatively, the truck operator must stop and manually scrape the carryback from the floor leading to excess labour, wasted time and decreased efficiencies, creating a negative impact on
a mine’s bottom line. If, for example, 50t of material is left as carryback after the first few trips of the day, and a truck makes two trips per hour – although three to four loads may be the norm – the result translates into a shortfall of 2,000t of material that simply is not processed during the course of the day.

High Performance oil-sands bodies incorporate hydrophobic steel in a patent-pending way, which effectively prevents the sticking effect. Hydrophobic steel is characterised by qualities such as: poor wetting, poor adhesiveness and having a ‘low’ free surface energy/ adhesion. When wetted, the water forms beads on contact with the surface, and any attempt to spread or wet the material results in the water molecules quickly reforming beads which won’t separate, spread or adhere to the material.

Specific oil-sands bodies strategically place hydrophobic materials in key problem areas of the body – those areas prone to sticking and carryback. Typically, those problem areas are where two planes of the body intersect, for instance, where the front wall and the sidewall connect, or where the front or sidewall joins to the floor. Attaching hydrophobic steel plates to those areas reduces angles, which helps to fight sticking. In addition, the hydrophobic properties repel the sticky material, virtually eliminating any carryback. It’s nearly impossible for anything to remain on the truck once gravity comes into play.

As an added benefit, hydrophobic steel liners can also be added as a retrofit to an existing truck body in order to improve productivity and minimise carryback in oil-sands applications.

The hydrophobic material is only one carryback-preventing element of specific oil-sands body designs. Operating in far northern reaches of North America, environmental conditions can significantly affect performance as well. In areas of the country where temperatures can exceed -40°C and stay there for extended periods, the cold weather serves as another obstacle to effectively releasing the load.

High Performance oil-sands bodies utilise the truck exhaust to provide heat to the body, reducing the ‘freezing on’ effect that frigid temps might elicit. Relatively simple in concept and application, the manifold heating system requires careful engineering. Different truck chassis provide the exhaust discharge in various locations, requiring specific configurations of the manifold system based on the make and model of truck being equipped. Additionally, while effectiveness requires that the heat be applied to areas prone to sticking, the distance in routing that exhaust must be short enough to ensure the exhaust does not cool, losing its heating ability and creating condensation on manifold surfaces.

This condensation of the exhaust gases can lead to a combination of the sulphur dioxide within the exhaust and moisture from the condensation combining to form sulphuric acid. Once this acid forms, it can pool within the truck body and result in serious corrosion. Evidence of this can be seen on some truck floors, where a simple metal rod can be pushed through the corroded floor of the truck. One exhaust routing system offered by Philippi-Hagenbuch effectively uses the exhaust for heating, while preventing any direct contact with the truck-body floor or structural components of the truck’s underside. As a result, corrosion effects are practically eliminated.

A PURPOSE-DRIVEN DESIGN

All of these changes have transformed the face of oil-sands mining from an industry making do with available ‘stock’ equipment to one equipped with a focused and dedicated fleet. And with the size and productivity required in the oil-sands industry, that is no small accomplishment.

Reflect, for a moment, on the size and significance of these operations. Consider that it took 2.6 million cubic metres of concrete to build the Hoover Dam in the US. That same amount of material could pave a 5m-wide highway from Seattle, Washington, to Pensacola, Florida. In contrast, that same amount of oil-bearing sand is mined and hauled over an average period of just four days. Think about it: 91 Hoover Dams’ worth of material moved each year, and, until now, no truck bodies specifically designed to handle the job’s unique aspects.

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