Massive advantage:

ADT pull scraper mining and civil applications in sub-Saharan Africa

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1. The history of scrapers

Wheel scrapers originated in the late 1930's as a civil engineering application used for earth moving. The scraper has a pan with a front cutting edge that cuts the material into the hopper that has a movable ejection system. Historically, it has been commonly used in the civil engineering industry for land levelling for surface infrastructure development, dam building, and earth moving in the form of shallow salt, coal, sand, or similar type materials over large target areas.

Over the last few years, the use of articulated dump truck ("ADT") pulled scrapers, transitioned more and more towards conventional mining applications.

This recent drive in the mining industry can largely be attributed to the following three prevailing conditions:

- Reliable, large, heavy duty **mining grade ADT pull scrapers** are now available in the market, supported by localised infrastructure
- Mining operations are under **increasing cost pressure** and are continuously looking at ways to improve their production and cost performance
- With the ever-increasing focus on sustainable mining practices, mining houses have increased their focus on methods to reduce their environmental, social and governmental **("ESG") footprint**, specifically with savings on water, reduced diesel consumption and lower emissions as priorities.

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2. ADT pull scraper for the sub-Saharan mining industry

In a strategic move set to transform the landscape of earthmoving and mining operations in sub-Saharan Africa, K-Tec Earthmovers, a leading manufacturer of mining-spec earthmoving scrapers, has announced a partnership with Ukwazi, a prominent mining services provider in sub-Saharan Africa. The introduction of ADT pull scraper applications to the sub-Saharan mining sector aims to reduce the cost of dry mining methods for suitable applications and replace problematic wet mining applications.

The available K-Tec, mining-grade ADT pull scrapers range from a maximum load capacity of 30.8t to 68.6t for single units, to 80t in a train configuration, powered by a single, standard 40t ADT power horse. These robust scrapers are easy to deploy, operate and maintain, and are fundamentally very different from the dual-engine motorised scrapers and agricultural specification scrapers historically used in the civil industry. The K-Tec ADT pull scrapers have been moving material for more than 20 years and on all seven continents. They have a proven track record of stripping overburden, mine reclamation, haul road maintenance, and transportation of mineralized material.

The material suitable for ADT pull scraper mining is generally loose material of a sufficient size distribution to be self-loaded, even if it contains isolated boulders of up to 300mm in diameter. When cutting and loading consolidated or partially consolidated in situ material, the hardness must be appropriate for mechanical cutting, based on the material-specific three-piece cutting edge. The targeted material must be sufficiently dry for ADTs to operate safely.

When fully loaded, a third of the load is transferred to the hitch, to promote traction on the ADT horse, and to limit the maximum load per tyre on the pull scraper back axle. The maximum load per wheel for the fully loaded 1237 ADT pull scraper is 10.2t and 14.5t in a train configuration. This is for an 80t load train, pulled by a single 40t ADT. Due to the innovative pull scraper design, the load is well distributed to allow for a balance between traction and load per wheel for optimal performance, when working under soft underfoot conditions.

3. Mining applications

3.1. Top soil and soft material for Cutback and Strip mining

The ADT pull scraper mining method for topsoil and softs benches is similar to the conventional load and haul methodology, except that a working bench loader is not required, and that a dozer is not required on the waste stockpile to level the dumped material. The ADT pull scraper mining method is self-loading on the loading bench and self-levelling on the dumping area.

When used in a train configuration, the load safely hauled by a single 40t ADT is double that of the same ADT in a conventional load and haul application. A dozer is required on the loading area for push-assist while loading and to move topsoil and sand in the corners of the block, into the cutting path of the ADT pull scraper train.

3.2. Tailing storage facilities

Where the ADT pull scraper functions as an alternative to wet mining applications, the purpose would be to replace selected hydraulic mining applications in cases where water is scarce or comes at a significant cost, or where the environmental permitting process for wet mining is expected to be problematic. In these cases, the operational cost of dry ADT pull scraper mining is significantly lower than the alternative of conventional load and haul. For wet mining applications, wet material handling to the material destination is required. This comes at a significant capital requirement due to the inherent specialization, complexity of the required infrastructure and reliable bulk services supply (electricity and water).

For dry mining applications, the production rate is generally not limited by mining activities, but more by the capacity of the (wet or dry) material handling, transport and processing systems. This could allow for significantly higher production rates per facility than with other methods. Ukwazi developed safe, efficient and cost-effective TSF slope reclamation mining methods with semi-mobile or fixed load out facilities

and material handling systems based on proven methods previously applied world-wide on TSFs and similar facilities.

3.3. Sand and salt mining

Dry sand mining methods are common at heavy mineral sands operations, either as primary production method, for the mining of outlier deposits and for dredge pond construction. This ADT pull scraper application is probably the most used historically.

Salt is produced through solar evaporation from sea water or salt lakes. Based on the exposure to wind and the sun, the water evaporates from the shallow pools, leaving the salt behind. The salt is harvested through dry opencast mining methods when it reached a specific thickness. The salt is either cut by a surface miner or ripped by a dozer or wheel grader and left in windrows. ADT train, pull scrapers self-loads the salt from these windrows, and move it to the central material handling system or process facility.

3.4. Surface miners

The use of surface miners is becoming more popular, specifically for bauxite, manganese and salt mines throughout sub-Saharan Africa. The surface miner mining methods are fully integrated with a hauling solution to the targeted destination.

The 'direct loading' method is based on direct casting into a truck. The 'side casting' method sees the cut material stacked on stockpiles and loaded onto trucks by a front-end loader, resulting in a significant in-pit stockpile inventory requirement. The 'cut to ground' method is a popular method due to the inherent de-coupling of the rock breaking, loading and hauling activities. For the 'cut to ground' method, the ADT pull scrapers in a train configuration self-load the windrows of broken material and hauls it to the centralized position for a cost effective, and safe solution.

4. A Clear advantage

The suitable soil types for the ADT pull scraper mining application is topsoil, sand, soil, clay, hardpan or a high-density sub-soil, coal, salt, material mechanically broken by surface miners or ripped hard layers in a soft material matrix, mineral residue deposits and TSFs. ADT pull scrapers, operated in a train configuration for appropriate applications, has a significant advantage relative to conventional load mining solutions historically used in sub-Saharan Africa for the following reasons:

- **Less capital intensive:** Pull scrapers require less equipment (~50% less horsepower) to move the same unit of material over the same distance relative to conventional truck and shovel operations for a lower dry unit cost
- **Lower number of staff:** Less maintenance personnel and operators for the same unit of material (~50% less personnel) moved relative to a truck and shovel/ excavator operation due to the lower number of engines and the low maintenance requirement of the pull scraper unit. This relates to less personnel exposure to injury and lower dry unit cost
- **Lower centre of gravity** when dumping material: Due to the high centre of gravity of ADT, the risk of rolling over, specifically while back-tipping in soft or uneven underfoot conditions is negated by the use of ADT pull scrapers
- K-Tec scrapers **excel in soft ground conditions**. In comparison to traditional motor scrapers that only have four tyres, and ADT and shovel/ excavator applications with six tyres per load, the pull scraper and ADT combination has 10 tyres spaced evenly across the machine, providing maximum flotation in soft and wet underfoot conditions
- **ESG advantage:** Additional to the lower level of carbon emissions relative to a conventional load and haul operation, the pull scraper application has a significant advantage relative to hydrological mining methods because of the water consumption, the associated water contamination and risk of contamination to surrounding areas
- **Significantly lower fuel consumption:** Because you have less horsepower to move the same unit of material over similar distances. The horsepower reduction is generally more than half. This directly relates to a significant saving in fuel consumption, a lower unit cost and lower levels of carbon emissions

- The basis of operation is close to a **continuous operation** with loading and dumping while moving with no waiting for trucks as with a conventional load and haul operation.

5. Sustainable mining practices

The demand for metals and minerals continues to increase at a faster pace as the average consumers' desire for electronic goods and mechanical equipment is not slowing down and the drive to clean energy transitions gathers pace. Highly volatile international inflation rates, the increasing cost of electricity, and ESG factors are just some of the external pressures that drives the upwards trend of mining costs. Internal cost pressures are affected by the fact that fewer large-scale, high-grade mineral deposits are being discovered. A significant portion of the discovered large-scale, high-grade deposits are in remote locations and will require significant capital investment in terms of local and regional infrastructure to unlock the opportunity.

This means that the available and potentially economic mining projects are getting smaller, deeper, have lower economic grades, and lower process recoveries and yields. This results in a higher saleable product cost, increased liabilities and mines that generate less revenue. Deeper ore bodies lead to increased waste stripping costs for surface operations, and capital-intensive underground mines with a lower flexibility on unit cost and production rate.

The role that the mining industry plays in the sustainable supply of metals and minerals is significant. To responsibly sustain our modern society, we need to constantly look at ways to produce more saleable products, despite the challenging physical parameters of the available ore bodies, while ever-increasing our focus on cost-effective sustainable mining practices that are low on harmful emissions and protect scarce water resources. The introduction of ADT pull scrapers have a role to play in the reduction of cost, and diesel and water consumption on sub-Saharan mines.