Ewelina Ptak, KH-Kipper, Poland, explains how to overcome the harsh, cold conditions faced by coal transporters every year.

Nowadays it is difficult to imagine a modern society without mineral resources. Coal is a high quality solid fuel that provides essential heat to people in many parts of the world – especially in harsh climates with severe winters. One of such countries is Russia. Average January temperatures in Eastern Siberia reach -30˚C and sometimes drop as low as -50˚C. Ensuring a steady supply of fuel for heating power plants or storage facilities is extremely important, especially in towns, cities and sparsely populated regions of the country. The time of delivery to the destination and the quality of transport can greatly affect peoples' quality of life.

Although coal mining is not a key sector of Russia's economy, it is not insignificant. The country is one of the top three countries with the largest coal reserves, although in terms of coal mining output it is in the fifth place, after China, the US, India and Australia. The popularity of this raw material in Russia is not decreasing. Although most of the

Figure 1. KH-KIPPER W1C mining body for coal transport.

Figure 2. The new generation of the HYVA ALPHA hydraulic cylinder provides shorter body lifting and lowering time.

coal is used to generate heat in the European part of the country, it is mined mostly in the eastern part of the country – Siberia.

Advantages of car transport

Transport of coal from the mining sites to consumers must not only overcome the difficult climatic conditions, but also be as economical as possible. It is performed on relatively short routes of 200 - 1000 km, when the amount of cargo is too small to make rail transport profitable or it is not technically possible to transport it by other modes of transport, e.g. rail, sea or air. Transport by tipper trucks can also be a part of a supply chain covering several modes of transport. Tipper trucks can be operated solely within a coal mine, as well as from the mining site to a railway transhipment hub, a port, the nearest storage site or even the place of its combustion – for example, a power plant.

Road transport on haul roads is chosen by those companies that do not have a direct connection to a railway line. If haul roads at a coal mine are properly prepared, tipper trucks can even replace traditional dump trucks. The advantage of the former is lower purchase and operating costs, and the more extensive network of truck chassis service points makes it easier to purchase spare parts and perform repair. Although they operate in relatively light operating conditions compared to typical mine tipper trucks, tipper trucks intended for coal transport are more versatile. Unlike dump trucks, they can not only move within the mine where coal is mined, but also on public roads, for which they do not need a special permit.

Tipper trucks are used for purposes other than transport

During transport by tipper trucks, it is important to consider the physical and chemical properties of coal, the difficulties in the delivery process itself, the loss of quality and the problems with unloading. Excessively high temperatures can lead to self-ignition and excessively low temperature can lead to freezing, which makes it difficult to unload the coal. During transport, coal may be fragmented due to vibrations, especially on poor quality roads, and can turn into a dust mixture at excessive speeds. Poor coal quality can lead to lower sale prices. During transport, it is difficult to avoid the natural loss of cargo due to wind or precipitation, such as rain and snow, and coal is often loaded on a tipper truck in excessive quantities and transported without any protection.

In conclusion, the coal carrier body should adequately protect the cargo from moisture or other aggressive substances and factors that could not only lead to deterioration of the quality of the fuel, but also could activate its dangerous properties. Coal transportation in Siberia is often carried out over considerable distances from service points, so in addition to the chassis, it is extremely important to choose the right truck body with optimum payloads, strength under extreme climatic conditions and trouble-free handling.

More body volume, more coal transported

Coal tipper trucks usually have load capacity of up to about 30 t, but when delivered to private customers, the load capacity may be even lower – up to 5 t. An example of a KH-Kipper rear chute body is a classic 'rectangular' body mounted on an 8 x 4 truck with load capacity of 33 t and maximum permissible weight of 50 t. It is designed to transport hard, lignite, or anthracite coal of the 0 - 300 mm size fraction. Hard coal, especially the fine one with a size fraction no larger than 50 mm, is relatively light. In order to carry as much load as possible during the day and to ensure optimum efficiency, the body must have as much volume as possible. In this case it is 31 m^3.

The reinforcement profiles in the side and rear walls stiffen the simple structure of the body and give it the appropriate strength. Its rigidity during loading and transport is increased by the two chains permanently mounted between the side walls.

The rear wall with top hinges opens automatically during unloading. Coal is transported all year round, including in winter. Loose coal tends to stick in the corners of the body during unloading, especially in the front section. To reduce this problem, the front wall is slightly inclined to allow the load to easily slide over it.

Due to the operating conditions in which coal tipper trucks are used, the top profile and the axis of rotation are properly reinforced. The roof, as an extension of the front wall, protects the cab and the hydraulic cylinder from damage during loading, and the rear axle wheels are protected with plastic or metal mudguards.

The foldable ladder attached to the front wall allows the driver to enter the body safely in order to fold or unfold a tarp

or to check the interior of the body. The side barriers under the body protect other road users by preventing uncontrolled entry from the side under the wheels of the truck.

The HYFIX lock additionally fixes the body to the frame and prevents upward and downward vibrations. This minimises damage caused when driving with an empty body on unpaved roads and roads in poor condition.

The spare wheel is placed behind the cabin rather than on the front body wall, so that it does not rise unnecessarily together with the body during unloading.

The structure must be strong

A company's productivity is determined by the time of the production cycle, and coal transport inside a mine is a complex process in which operations are mutually dependent. Any downtime in the operation of a means of transport caused by a defect and the need for repair entails unnecessary costs.

To minimise such problems, KH-Kipper bodies for coal transport are made of high quality Hardox steel, produced by the Swedish steelworks SSAB. The floor of the body is made of 8 mm thick steel and the sides from a 6 mm thick steel sheet. The material provides high resistance to abrasion and spot impact and extends the service life of the body and the period of failure-free operation of the means of transport. A reliable design is extremely important if the tipper truck works in difficult operating conditions or in the absence of adequate service infrastructure.

Hardox steels make it possible to optimise the weight of the body and to increase its load capacity. They are strong enough to use thinner sheets and thus to achieve lighter structures. Although such bodies are lighter, they still retain their strength and long service life. Modern materials provide greater efficiency and time savings by enabling transport of more cargo during the same period of time. In an era of rising transport costs, vehicle payload is particularly important because it means lower fuel costs and, in the long run, increased competitiveness of a company.

The use of modern steels also has an environmental element – lower fuel consumption results in lower carbon dioxide emissions.

Shorter lifting time

The new generation of the HYVA ALPHA hydraulic cylinder, used in KH-Kipper rear-discharge bodies, provides approximately 20% shorter body lifting and lowering time. A lighter, yet stronger, hydraulic system also increases the payload of the tipper truck.

With repeated cycles, the new solution enables using the saved time for performing a larger number of cycles and thus transporting more cargo. According to the manufacturer's declarations, in case of installation on an 8 x 4 vehicle and a cylinder stroke of 5 m, the savings are 388 more unloadings per year in the mine's working standard and 48 t more load in the case of a construction tipper truck. These are real benefits for companies.

Every detail of the new hydraulic system has been redesigned and optimised. A reduced of the cylinder

Figure 3. KH-Kipper bodies for coal transport are made of HARDOX steel and produced by the Swedish steelworks SSAB.

diameter means less oil in the hydraulic system. The HT control valve mounted on the cylinder is equipped with a safety valve to prevent the body from falling down suddenly if the hydraulic hose breaks. The special design of the valve protects the cylinder against pressure surges, such as when the driver shakes the body or operates on unstable terrain. The insert in the valve protects against access of unauthorised persons who could try to change the hydraulic pressure parameters.

The changes resulted in a complete hydraulic system that is lighter, faster, more reliable and safer than any other system available on the market today.

Safety is the most important

Transport and unloading, especially in winter, can be carried out after dark or in difficult terrain, which means that the driver of a tipper truck has to face additional challenges that threaten him or others in the vicinity of the truck. In the case of uneven material discharge, the body is tilted, which may cause the vehicle to tip over.

The scissor stabiliser located between the body and the chassis provides safety during unloading by reducing lateral forces acting on the cylinder. It prevents sideways leaning when material sticks or is unevenly distributed. The repair supports provide safety during maintenance and repairs requiring entry under the body. The side barriers under the body effectively prevent uncontrolled entry from the side under the wheels of the truck and the steel bumper protects other road users from being trapped under the vehicle in case of a collision.

Coal mining often takes place in conditions with limited visibility, not only in winter after dark, but also during polar nights that last for months. The vehicle can be clearly visible even after dark, even from a greater distance thanks to the reflective tape, high visibility plates, and yellow marker lamps. WC