

Environmental benefits of high strength steel in dumper trucks

Did you know that...

- The use of high strength steel in dumper trucks makes it possible to increase the vehicle's load capacity, which leads to more efficient transportation.
- For every ten thousand tonnes of high strength steel that replaces conventional steel in vehicles, the greenhouse gas emissions decrease by 120 000 tonnes CO_{2e}. This is equivalent to the annual emissions of 50 000 private cars in Sweden.

The world needs Swedish steel

Steel is the world's most used metallic construction material thanks to the material's strength in relation to its weight and price. During 2013 almost 1.6 billion tonnes of steel were produced globally.¹ Sweden's steel industry makes up about half a per cent of the world production. However, Swedish steel companies are highly specialised. In many cases they are world leaders within their respective niches.²

Steel forms part of an eco-cycle and can be recycled endlessly as raw material for new steel without any deterioration in quality. This makes it unique amongst modern materials.

New, advanced steel grades are being developed all the time. Many of the steel grades that Swedish steel companies produce today were not even on the market five years ago.³

High strength steel is stronger than conventional steel and enables the production of lighter steel designs. A doubling in the strength delivers a weight reduction of about 30 % in the upgraded structural components.³ Upgrading means replacing with a steel of higher yield strength. Lighter structures lead to lower environmental impact through reduced emissions, more energy-efficient products and the sustainable use of natural resources.

Case study

For vehicles that transport heavy payloads, a weight reduction frequently means an increase in the vehicle's load capacity. Greater load capacity means that fewer journeys are required to transport a certain quantity of goods which leads to reduced impact on the environment.

In a case study³, through life cycle assessments, an investigation has been made into the environmental benefit of upgrading the steel in the bogie frame of a dumper truck to high strength steel. One important factor in the upgrade of structures to high strength steel is to avoid the fatigue of welded components. Since there were certain critical areas in the previous bogie frame it was necessary to change the design of the frame. Before the upgrade, the steel in the frame had a yield strength of 350 MPa, while after the upgrade the yield strength was up to 600 MPa.

In the life cycle assessments are included the

¹ World Steel Association

² Jernkontoret, *Steel shapes a better future*

³ *The Steel Eco-Cycle, Environmental research Programme D 853.*



environmental impact from production of the steel for the bogie frame, the transportation of the steel as well as fuel consumption during use of the dumper truck.

Dumper trucks are normally used to transport heavy freight and the transport journeys are assumed therefore to be weight critical. This means that reduced vehicle weight can be directly translated into increased load capacity. Half of the transport journeys are assumed to take place with full load.

The dumper truck's total lifetime performance is estimated to be 20 000 hours.

Results

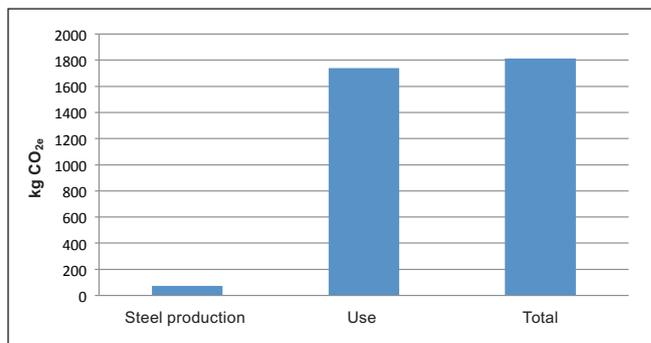
The bogie frame's weight before the upgrade was 183 kg. Through upgrading the plates in the frame to high strength steel these could be made thinner, and the weight could be reduced by 39 kg, which corresponds to an approximate 21 % reduction for the upgraded parts. The dumper truck's load capacity thereby increases by 39 kg. The weight reduction also results in reduced fuel consumption for transport journeys with empty loads.

In total, the emissions of greenhouse gases are cut by about 1 800 kg CO_{2e} during the dumper truck's life cycle. The greatest part of the reduction in emissions arises as a consequence of lower fuel consumption during operation of the dumper truck. A smaller part is due to lesser amounts of steel required to produce the frames in high strength steel compared with conventional steel.

The total production costs are 8.6 % lower for a bogie frame in high strength steel compared with a frame in conventional steel, owing to lesser material consumption and less metal cutting being needed. Reduced fuel costs for the dumper truck lead to further savings of about SEK 9 000 during the dumper truck's lifetime.

Conclusion

A weight reduction of 39 kg is a relatively small decrease in terms of the total weight of the dumper truck of 69 tonnes. The case study aims to exemplify applications of high



Reduced emissions of greenhouse gases from steel production and operation of the upgraded dumper truck.

strength steel and how the results can be used to calculate the effect of upgrading various parts of the vehicle.

An analysis of the future potential for emission reductions, based on the calculations in the case study, shows that for every ten thousand tonnes of high strength steel that replaces conventional steel in vehicles, the greenhouse gas emissions decrease by 120 000 tonnes CO_{2e}. This corresponds to the annual greenhouse gas emissions from 50 000 private cars in Sweden.^{4,5}

Swedish steel and the companies' knowledge of its applications create opportunities for manufacturing more efficient structures that reduce environmental impact when the products are used. The use of high strength steel in vehicles is one example of this potential.

This shows the importance of paying attention to the environmental impact during the steel product's entire life cycle, and not only examine the environmental impact from the production of the steel itself.

The properties of steel in terms of high strength, long operating life and recyclability make the material a significant component of sustainable development.

⁴ Swedish Environmental Protection Agency. www.swedishepa.se

⁵ Transport Analysis. www.trafa.se

Do you wish to know more? Please contact us at Jernkontoret.

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