Profiles

IEA CLEAN COAL CENTRE

No 12/18 December 2012

Losses in the coal supply chain

Data from the IEA suggests that global coal production has increased from less than 4000 Mt in the 1980s to 7200 Mt in 2010. In mass terms, the growth has been overwhelmingly from bituminous coal, although coking coal and subbituminous coals have seen significant growth also. International trade has maintained a similar growth, accounting for some 15–20% of global supplies, at least for steam coal, coking coal trade is even higher. More coal is being mined and transported across the world than ever before.

This report raises some of the issues that may affect a tonne of steam coal as it moves along the supply chain from the minemouth to the customer. The report also discusses some of the potential confusion that can arise when looking at this subject. It is impossible to produce a complete list of locations and reasons for coal losses (or additions through exposure or contamination) as each mine operation is unique with varying supply chain lengths.

If a customer wants a tonne of coal, the reporting procedure must ensure that a tonne of coal passes all the way down the supply chain. If it doesn't, then coal will need to be found further down the chain, but quantifying this is not straightforward. This report examines the losses experienced along the coal supply chain, which may result in a reduction in the quality or value of a consignment of coal.

Few papers are published and relatively little importance is paid to the losses that might occur throughout the coal chain in terms of reports and published materials. While there are likely to be other losses along the coal supply chain, some industry analysts admit there are few attempts to quantify them.

Losses start at the mine, with either incomplete extraction of the seam, leaving coal in the ground, or over mining at the peripheries, or incorrect blasting of overburden rock therefore diluting the coal with excess waste rock, causing a loss in heating value of each tonne of extracted material. Different areas of the coal seam can lead to varying losses.

Intentional losses such as the coal left in the supports for room-and-pillar mining can be substantial, in extreme cases up to 90% of a coal reserve, but typically more like 40%. Possibly the largest source of mass loss in the coal supply chain has to be the preparation plant, removing mineral matter and inert inorganic substances that cannot otherwise be burned.

These waste extractions lead to a cleaner more mineral free coal product, so called washery yield. These yields vary widely across the world, with yields ranging between 40-90% depending on the coal and the need for processing.

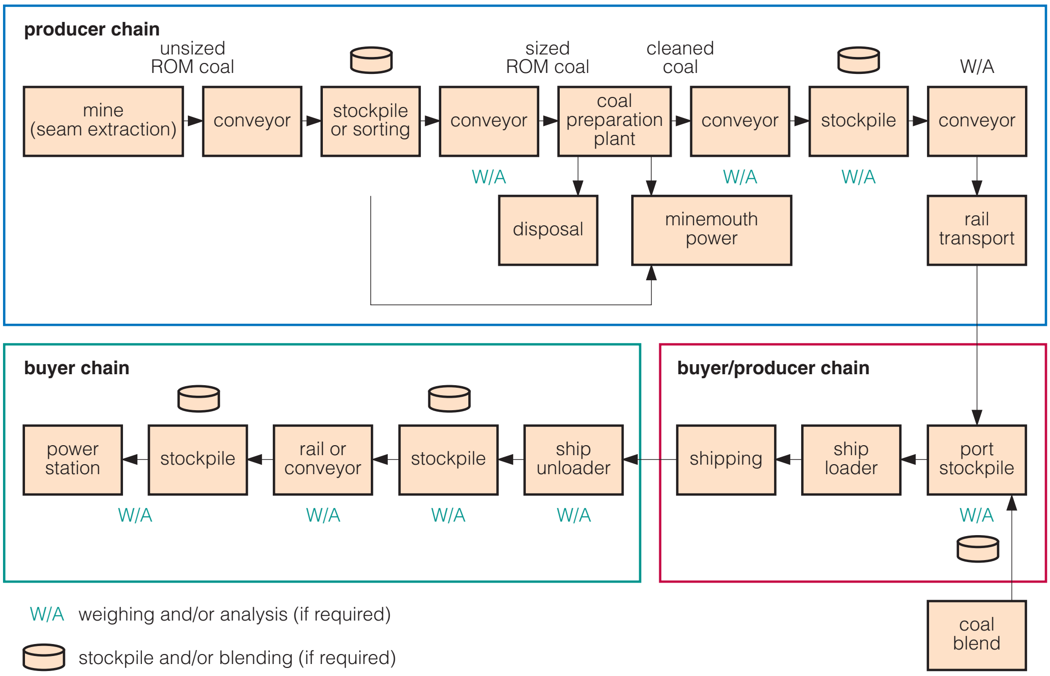
Coal washeries can account for 20-30% mass loss through the separation processes of mineral matter from the coal. Depending on the coal, the separation of fine coal can be a large part of this loss. Fine coal can be utilised separately or stored in settlement ponds, but is usually not a desirable material to transport with the coarse and intermediate coal fractions. It is possible that some 430–1090 Mt of waste could be rejected from the world's coal washeries, some of which is coal.

The actual mass of material that would yield a heating value from the world's washeries is unclear, but studies done on fine coal (<0.5mm) suggest in the USA, fine discards alone could be 70-90 Mt/y, equivalent to roughly 10% of the country's saleable coal production.

Maintaining a check on the mass of coal passing through the supply chain from mine to end user is naturally fraught with error, but efforts to track coal tonnage are easily done using stockpile surveys, weighing mass on conveyor belts during transit, or draft surveys of ships for seaborne traded coal. The accuracy of such measurement systems is high but still gives a small error of ±0.5-5%.

Losses in mass and heating value of coal due to spontaneous/self combustion are small, perhaps 0.5% in some examples, but this is dependent on the conditions of storage, the access to air flow, and the residence time of the coal stock in its static state. The priority for this type of combustion during transit and storage is the hazard that is posed by the production of heat and carbon monoxide that can be potentially lethal.

Losses from spillage and dust can be sizeable if not properly controlled. Fully covered conveyor systems and enclosed storage depots can minimise dust loss during windy conditions. Similarly, dust loss from coal wagons from rail haulage can also be considerable. Dust can either be windblown, or washed away with rainfall. At best it is a nuisance, at worst it is a hazard for both respirable health or leaching into the environment.



Coal supply chain for a typical export coal

Dust loss and spillage occurs anywhere along the chain where there is exposure to weather, and especially during transit and transfers between two modes of transit, whether it is conveyor to conveyor, conveyor to ship, hopper or dumper truck to rail wagon and so on. Simple and cost effective methods of minimising dust include water spray, but surface moisture can increase by up to 4%.

In some countries, theft of coal is a problem. This makes production data difficult to reconcile with the actual supply of coal to end users. As such considerable amounts of coal can be lost in the statistics as losses or merely ‘statistical differences’.

Biomass incurs many of the problems associated with coal, for instance the removal of mineral matter that is often acquired during the loading and moving of biomass. Dilution of the biomass matter can a problem. Biological degrdation can lose 1% of useful fibre per month.

Finally, it is at the power station where perhaps the greatest losses occur. In the first instance minor losses might happen at the milling stage, with stockpile reclaiming and conveyor transportation experiencing the same losses seen in the coal mine, and where the milling equipment can generate some losses in pulverised fuel. The power station fuel preparation stage can lead to further rejects of shale and iron pyrites.

The largest loss is that occuring during the conversion of fuel through the process of combustion and conversion to electricity. The efficiency of the power station can lead to losses of coal of 55–70% (in energy terms). In terms of mass, the waste ash and byproducts of flue gas cleaning equipment can be reused, so in effect, the residues of coal and the emissions are all that are tangibly left of the coal at the end of its journey along the coal chain.

Understanding mass loss of coal at the power station is as varied and complex as attempting to understand it further upstream. Quantifying these losses is a difficult task, and possibly too small to be of concern. However, identifying the locations and events that occur to a tonne of coal from the seam to the power station is more straightforward. Ensuring best practice in coal mining, preparation, transportation, and finally in combustion should ensure efficient use of a depleting resource and longevity of the world’s reserves.

Due to the variability in coal supply chains across the world, this report is at best an overview of a representative coal supply chain. This an introduction to explore some of the issues that make up certain elements of the supply chain where both large and small losses occur. There may well be need for further research in many areas of this study.

Each issue of *Profiles* is based on a detailed study undertaken by IEA Clean Coal Centre, the full report of which is available separately. This particular issue of *Profiles* is based on the report:

Losses in the coal supply chain
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CCC/212, ISBN 978-92-9029-532-7,
66 pp, December 2012, £255*/£85†/£42.50‡

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