Dr Roland Aeckersberg, Loesche GmbH, Germany, explains how processing low-rank coals can make them suitable for use in several applications.

Low-rank coals (LRCs), such as lignite and sub-bituminous coals, have high total moisture contents. These typically range between 30–70%. This usually limits their use to the direct surroundings of the coal deposit, because transport is not economical. Therefore, a common use for LRCs is electricity generation in mine mouth power plants. However, it is often the case that the location of the coal deposit is not close enough to electrical consumers. This in turn means the economic feasibility of such a power plant may be questionable, because of the development costs for power distribution. Additionally, the emissions of carbon dioxide are higher than in conventional coal-fired power plants.

Accordingly, the drying of LRC is the solution to produce an economical tradable fuel. Different drying technologies to upgrade LRC were developed with various drying agents (e.g., steam, oil, microwave radiation) and are in commercial operation or at the pilot plant stage. Traditionally, LRCs are upgraded in tubular dryers at industrial scale. These dryers use indirect contact drying of the pre-crushed coal, with saturated steam (typically low pressure steam at about 160 – 180°C; 3 – 4 bar [g]). Because of the required steam for the drying process, LRC upgrading with this technology is typically combined with power generation. However, this drying method is accompanied with a loss in power generation, due to the steam extraction in the steam turbine.

In order to avoid reliance on steam or other special drying agents, Loesche GmbH has developed the Coal Enhancement Process (CEP). With this process, high moisture coals can be upgraded for a variety of applications that require low moisture contents (for example, coal gasification). Furthermore, the produced LRC dust from the CEP may be briquetted in a downstream process to obtain a tradable fuel, which is manageable and has a greatly reduced water content. LRC briquettes also benefit from the upgrade because the risk of spontaneous combustion is almost negligible.

The CEP

The CEP is based on the self-inert coal grinding and drying process by Loesche. This process is well established for coal preparation in cement plants and iron works for pulverised coal injection (Figure 1). However, the main difference between this established process and the new CEP is that a fraction of the upgraded LRC is separated and used in the integrated hot gas generator (HGG), in order to produce an oxygen-depleted hot
gas for the drying process, as well as a transport agent in the coal mill.

The adapted CEP flow sheet is shown in Figure 2. For explosion protection, ferromagnetic materials and nonferrous metals are discharged out of the raw LRC, before being fed into the coal mill. Inside the mill, the raw coal is comminuted and simultaneously dried with an inert hot gas. The gas is also used to transport the produced coal fines to the top of the mill. There, the coarser particles are repelled in a classifier and returned to the grinding parts for further comminution to the required fineness. The fineness can be adjusted to approximately 0 – 6 mm.

Those coal fines that have not been repelled are pneumatically transported to the bag house filter. From there, the fines are separated from the process gas. After the filter, the LRC fines are divided into two streams. One stream is fed into a stand-alone mechanical air separator. Inside the separator, an air swirl is generated that separates the finer coal particles from the coarser ones. The finer coal fraction (approximately 20% R90µm) will be stored in a dosing bin, as fuel for the HGG. The coarser coal particles are reunited with the second coal stream from the baghouse filter and are buffered in a product silo for the following process.

Downstream, gas from the filter is divided into two gas flows. One part is dissipated through the stack into the atmosphere. The second is recirculated in the process to the HGG. The upgraded and separated LRC fines are combusted in the LOMA®-Heater (a stainless steel combustion furnace). The recirculated gas is mixed with the flue gas and thus heated to the required temperature for the drying process inside the mill. Hot inert gas, with an oxygen content below 12%, is then injected into the mill to evaporate the LRC water.

Because of the reactivity of LRCs, the CEP is equipped with various safety measures. In normal operation, the oxygen content should be below the limiting oxygen concentration, so no explosive dust/air mixture should occur inside the dust carrying plant equipment. An ignition source should be avoided in any case. Nevertheless, the oxygen concentration is constantly measured and will shut down the plant if the concentration exceeds a certain level. For safety reasons, the plant is equipped with explosion pressure relief vents to release the explosion pressure in case of an incident.

If the specific application of the upgraded LRC requires a finer particle size, the cold milling process provided by Loesche could be used as a downstream process. Ambient air (with full oxygen content) is used as a transport agent to mill the coal down to fine pulverised coal.

### Technical feasibility

To prove that the CEP works, Loesche has performed a technical feasibility on its CGP mobile (mobile coal grinding plant; Figure 3) with light fuel oil in the HGG.
instead of LRC dust. The main purpose of this study was to investigate the achievable differential moisture after the drying and grinding. Six different LRCs (LRC 1 – LRC 6) with high moisture contents were sourced worldwide from different coal deposits. These coals have been investigated in this study. The total moisture of these raw coals ranged between 46 – 56% mass. All coals were processed with three different settings whereupon only one process parameter (fineness) was changed on purpose and some dependent process parameters were automatically adjusted by the process control system. A review of all the achieved drying results is shown in Figure 4. Setting 3 provided the best drying results for all the coals, with a maximum drying of 51.4% for LRC 4 at setting 3, while the lowest drying results were achieved with setting 1. However, the lowest difference between feed material and product was still 38.6% for LRC 3.

The briquetting properties of the produced coal dusts were also evaluated on a laboratory-scale double roller press, with a sensitivity analysis on briquetting pressure. All briquettes from the eighteen produced LRC dusts showed very promising briquetting results (Figure 5). Compared to a traded thermal coal, the abrasion was almost the same or even better and the briquette stability was equivalent or better.

Consequently, the technical feasibility of the CEP with downstream briquetting was approved and high drying rates were achieved, thus high moisture LRC could be processed with the CEP.

Nevertheless, there are still some investigations to be carried out. The current development of the coal price does not simplify the hurdles to be overcome.

References
Loesche – worldwide presence

Loesche is an export-oriented company run by the owner, which was established in 1906 in Berlin. Today the company is internationally active with subsidiaries, representatives and agencies worldwide.

Our engineers are constantly developing new ideas and individual concepts for grinding technologies and preparation processes for the benefit of our customers. Their competence is mainly due to our worldwide information management. This ensures that current knowledge and developments can also be used immediately for our own projects.

The services of our subsidiaries and agencies are of key importance for analysis, processing and solving specific project problems for our customers.

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