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Sulphur removal from coal or from products: is prevention better than cure? - a techno-economic review

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2009-07-01T12:50:49Z
http://hdl.handle.net/10539/7060

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2 OPPORTUNITY STATEMENT

The Synfuels and chemicals production of the Sasol Secunda complex will increase continuously, due to increased national demand, continuous improvement strategies as well as through capacity increases resulting from process changes and capital expenditure. Although some of the increase may be based on natural gas as feed material, coal remains the dominant feed stock. Increased coal intake to the gas production section increases the per hour sulphur load on the raw gas purification system and consequently on the sulphur removal system for the Rectisol off-gas stream.
This has been identified as a major challenge. In addition to the increased feed material intake, it is also very likely that the sulphur content of the coal will increase with the move of the mining operations into different quality coal areas. This increases the sulphur load on the recovery units even further.

The easiest approach to problem solution is to continue with the application of “more of the same” technologies. This is a perfectly acceptable method as long as the employed existing technologies are effective, expandable and relatively affordable.

The Sasol Synfuel complex in Secunda has expanded over the last 25+ years, and several units within the complex have used large parts of the area originally allocated to the units. Hence, “more of the same” may not be possible since available plot-space is limited. If the units could be expanded within the available plot-space, then the question of effectiveness needs to be answered. It is most likely that the Rectisol raw gas purification process will be able to remove all the sulphur species to the extent required by the Synthol process. The Rectisol off-gas stream to the sulphur recovery process will increase in volume though, and, depending on the sulphur content of the coal gasified, also in sulphur concentration. Given a relatively fixed sulphur recovery efficiency of the Sulfolin process, this means that the off-gas of the Sulfolin unit will contain more sulphur on a per hour basis and sulphur emissions to the environment will increase.

Emission of sulphur as hydrogen sulphide into the atmosphere is allowed under a Governmental permit system. Increasing the emissions will require a re-negotiation of the permits, and, considering Government’s desire to reduce potentially harmful emissions in general even further, this may be a difficult task to achieve successfully. Hence, emission abatement steps are required.

There are two approaches open to reduce the emission of sulphur into the atmosphere:

- Increase the sulphur recovery ability of the Rectisol off-gas treatment units through expansion of the existing units or by employing new or alternative

technologies in addition to the existing units, or as replacement of existing units (treat the symptoms)

- Reduce the sulphur load presented to the off-gas treatment units by reducing the sulphur intake into the gas production system, through coal beneficiation (treat the cause)

Depending on the economic and technical viability of the approaches, either approach could be used on its own, or in combination with the other.

An alternative would be to change the quality of the coal fed to the gas production system by selecting different coal sources. Given the large volumes of coal consumed by the Secunda complex, it is unlikely that an alternative (and affordable) supplier can be found. Also, from a National Resource utilisation perspective it would be beneficial to use as much as is possible of the available resource, and not to employ selective mining strategies whereby sections of the reserves are left behind and effectively sterilised for ever.

In the past, focus has been on the existing sulphur recovery units in a bid to increase efficiency and total sulphur recovery. Very little attention has been paid to treating the cause by addressing the potential reduction of sulphur intake into the system through total or selective beneficiation of the coal fed into the complex. So much so, that the analysis of coal and evaluation of beneficiation potential – standard to the normal coal mining operations in South Africa – was not done at all on the coal supplied to the Synfuels complex. Even the geological evaluations of the coal in the reserves initially excluded beneficiation related analysis although this has fortunately changed and for quite some time washability evaluations are done on the borehole cores. Coal sampling and washability evaluations therefore needed to be done from scratch, as well as the determination of the distribution of sulphur species over the various size and density fractions before the potential of coal beneficiation can be determined.

To expand or improve the existing sulphur recovery processes would be a major challenge since plot-space has indeed become limited and additional equipment may be difficult to place, and the potential for improvements to process efficiency has been found to be even more limited. The current approach by Sasol therefore is to consider alternative sulphur recovery technologies to capture the sulphur from the off-gas of the current systems, or to process Rectisol off-gas in parallel to the existing Sulfolin units. These alternatives are however also restricted by available plot-space. In addition to that, these alternatives are rather capital expensive.

The challenge therefore is to evaluate the benefits of the coal beneficiation alternative to treating the symptoms, and to prove that addressing the cause of sulphur in the gas production system is indeed viable if not more desirable than expanding the gas treatment units.

This thesis will address that challenge.

The opportunity in this challenge is to show that a solution based on coal beneficiation has wider application than just emission abatement alone. The possibility exists to increase the utilisation of the available coal reserves by applying coal beneficiation technology to coal mined in areas, which would normally be deemed as unsuitable for the gas production processes in un-beneficiated form. The increased reserve utilisation will extend the supply of coal to the Secunda Sasol Synfuel complex, and allow it to continue making substantial contributions to the net income of the Sasol organisation.

To be able to answer this challenge it is required to better understand the coal origin, quality, and reserves, as well as the processes in which the coal is used.
Chapter 3 provides this background.