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UPRATING OF COAL CONVEYOR SYSTEMS AT SASOL TWO AND SASOL THREE

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UPRATING OF SASOL TWO AND SASOL THREE COAL CONVEYOR SYSTEMS

1. INTRODUCTION

It was decided by Sasol in June 1984 to debottleneck both the Sasol Two and Sasol Three factories to raise production by an increment of 6%.

The coal distribution system was identified as a major restriction which had reached its limit, and which required uprating to provide not only increased capacity, but also improved flexibility.

Changes had to be carried out on an operating plant with only minimal downtime opportunities at scheduled factory shutdowns.

Further investigation confirmed that pre-investment to raise production by a further increment of 14% was attractive to ensure that the coal distribution system would meet the expected ultimate factory production.

Proposed improvements included belt widening, increased speed of belts, enlarged and re-designed chutes and loading points, and improved tripper cars. These changes would provide 100% conveyor standby and permit effective maintenance, minimise coal degradation and spillage, eliminate chute blockages and afford increased flexibility to the conveyor belt system feeding the gasifier bunkers. The required total investment amounted to some R40 million for the two factories.

2. DESCRIPTION OF ORIGINAL SYSTEM

Coal from four adjacent mines is fed to the Sasol Two and Sasol Three factories by a system of belt conveyors.

Initial treatment of the coal is sizing by wet screening. Coarse coal is sent to the gasifiers as the first step in the overall production process. The undersize and fines are diverted to the Steam Plant as boiler fuel.

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The coarse coal is conveyed to the top of the Gasification Building on four conveyors, the head ends of which form the southern distribution point. 50% of the coal stream is diverted to the southern wings of the Gasification unit, with the balance sent to the northern distribution point on a further four conveyors, before being distributed to the northern wings of the unit. Gasifier conveyors discharge into the bunkers by means of belt trippers.

3. LIMITATIONS OF ORIGINAL SYSTEM

3.1 The intended operating philosophy of the plant at the design stage had been to use half the system to feed coal to the gasifiers, with the other half as a running standby. Increased coal demands had made it necessary to operate both halves of the system simultaneously and plant maintenance inevitably deteriorated. It thus became essential to restore the original philosophy.

3.2 The existing system as installed had reached the limits of its coal carrying capability. Expedients such as increasing belt speeds had served only to highlight the inadequacy of transfer point design.

3.3 Frequent blockages of the tripper car chutes, and the resultant coal spillage in the restricted access walkways, represented a serious operational drawback.

3.4 High wear rates on certain equipment items, particularly chute liners, required improvement in order to reduce maintenance downtime.

3.5 Corrosion, particularly in the transfer chutes, led to serious coal spillage at transfer points.

4. OBJECTIVES OF DEBOTTLENECKED SYSTEM

The principal objective was to provide a coal distribution system capable of handling coal at the expected ultimate factory production rate (a 20% production increase).

An essential objective was to provide sufficient capability in the system to permit continuous operation with a running standby.

Since the gasifier bunker capacity could not be increased, and additional gasifiers had been added, it was important to ensure that the belt trippers maintained the required transfer rates.

Remaining objectives to overcome design deficiencies included :

- improvements to transfer points by relocating coal trajectories
- reduction of chute wear by improved lining materials
- minimisation of corrosion by use of corrosion-resistant chute body material
- maximised utilisation of existing headroom by efficient transfer point design. Headroom limitations in the existing plant buildings limited the choice of alternative transfer methods to improve the system.

5. IMPROVEMENTS IMPLEMENTED

5.1 Best efforts to upgrade existing system

The previously described limitation of space, allied to the need to maintain continuity of production, meant that a major redesign of the coal flow circuit could not be considered. The designers were therefore faced with the familiar problem of accepting an existing system and making the best possible efforts to upgrade it.

5.2 Advantages of application of swing chutes

Due to the fact that modifications to each factory involved thirty conveyors with their attendant transfer points, it was decided to group the conveyors according to whether they could be increased in width, in speed, or both. It immediately became obvious that, regardless of the type of conveyor improvement, the increased coal flow in the headroom available would not permit conventional coal flow path selection by means of flopper gates. After considering a number of other alternatives, all of which were discarded because of the need for short horizontal conveying of coal due to insufficiently steep chute angles (i.e. below 50°), the decision was made to use multi-directional swing chutes. The principal advantage was the ability to simultaneously split and direct the coal flow in more than one direction. The operation of these chutes was by pneumatic cylinders with proportioning valve control, allowing the accurate proportioning of coal fed in each direction. This pre-determined feed onto the wing conveyors ensures the most efficient filling of gasifier bunkers.

The most common criticism of the swing chute concept of transfer point design is the necessity to enclose all the components to contain the dust generated. In the case of the Sasol Two and Sasol Three factories, conditions were practically ideal, since the coal distribution takes place after the wet screening process with the result that the fines have been removed, and the coal has a high proportion of surface moisture. Dust generation is therefore minimal.

5.3 Setting of parameters

The major objective of the belt conveyor uprating programme was to follow good engineering practice at minimum cost. Basic parameters used were :

- maximum acceptable belt speeds
- percentage trough filling
- proportioning cross-sectional area of all transfer chutes to a combination of lump size and flow rate
- provision of maximum availability for maintenance.

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Critical design parameters were based on those contained in CEMA (Conveyor Equipment Manufacturers Association) publication "Belt Conveyors for Bulk Materials" in conjunction with Sasol plant operating experience.

The problem of a high rate of wear on transfer chutes received considerable attention. The difficulty of simultaneously providing long life, low frictional resistance to coal flow, and acceptable cost is too familiar to warrant explanation. Additional factors considered by the design group were :

- the difficulty of providing dead-boxes which would function with wet, fine coal;

- the necessity of reducing coal velocities in order to minimise degradation, since an excess of fines affect gasifier production.

These problems were aggravated by the abnormally high abrasion index of the coal due to lenses of limestone containing calcitic/dolomitic nodules in bands in the coal seam.

Practical tests and cost comparisons indicated that a combination of alumina tiles in high wear areas and plate liners in less arduous conditions would provide the most effective combination.

The problem of chute corrosion was approached once again from the viewpoint of life/cost comparison. Various corrosive elements in the water used in both the wet screening process and the belt washing resulted in rapid deterioration of chute bodies. As in the case of wear-resistant linings, a combination of practical tests and cost effectiveness was used to determine the most suitable materials. Locally produced corrosion-resistant steel in an all-welded construction, using stainless steel fasteners, was finally selected as the most cost-effective form of construction.

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6. CONCLUSIONS

6.1 The designers faced a difficult task in upgrading an existing system. Space limitations, particularly in buildings and structures, presented a major obstacle in the design of conveyor improvements. The scope to utilise equipment not normally suitable e.g. swing chutes, presented considerable advantages in that it would otherwise have been necessary to raise the height of conveyor buildings and structures. This would have necessitated completely unacceptable total factory shutdowns.

6.2 Very high factory coal consumptions resulted in requirements for coal feedrates in excess of the industrial norm. Coal consumption of $\pm$ 15 million tonnes/year/factory required certain conveyors with a design capacity of 2 800 tph of Run-of-Mine coal. This is approximately equivalent to a volumetric flow of one cubic metre per second through the transfer points, which while not abnormal for stacking and reclaiming or shiploading, is far in excess of the average in-plant conveyor.

6.3 The limited time to install the improvements to the coal conveyors required particular attention on the part of designers. The factory shutdown philosophy is to take half the factory off-line every two years for approximately two weeks.

6.4 The successful implementation to date of approximately half the total improvements in the Sasol Three factory has supported the design principles employed, with no necessity for any significant changes. Construction plans and schedules developed between the project, contracting and production groups ensured that the modifications were completed not only within the minimal allocated time but ahead of schedule.