STACKERS AND RECLAIMERS ADD VALUE TO MINERAL PROCESSES

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Stockpiling costs money. Stockpiled material represents dead working capital. The action of stockpiling and reclamation can be expensive. It is for this reason that the apostles of Just In Time, of which the author of this paper is one, attempt to eliminate or minimise stockpiles.

Stockpiles also reduce the reliability of the total process. Breakdown of stockpiling equipment also affects the main process plant. In fact, stockpiling machines are highly sensitive and if not treated correctly can result in catastrophic collapses which put the process plant out of business for extended periods. The author has witnessed stackers running away in high winds, stackers falling over backwards, a stacker falling forward onto its boom, a stacker boom collapsing under strain, a bridge reclaimer boom embracing the stockpile after having run away from maximum height position .... !

Are we then not crazy to specify stockpiles in our mineral processes? This paper deals with some of the good reasons for having mechanically operated stockpiles.

The History of Stockpiles

Mineral processing plants form part of a bigger system. Minerals are produced and delivered to the process plant. The products from the plant are transported by some means to their various destinations.

The first mineral stockpile was formed when the first mineral process plant broke down and the raw material producers refused to stop production. The second stockpile was formed when the product transportation system broke down and the process plant refused to stop production! The formation of these stockpiles probably entailed the re-direction of the wheel barrows to tip onto a ground stockpile which was subsequently reclaimed by newly employed shovellers into newly acquired wheel barrows to re-introduce the material into the process! Until fairly recently mineral processors adopted the principle of running raw material straight into process plants unless production exceeded the process rate, either due to breakdown or design. Only excess material was diverted onto stockpiles.

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The evolution of stockpile design has for a long time followed the technology of material transportation. The wheel barrow era was followed by hand transported side tipper hoppers on railway tracks. These were also pushed up inclines and side tipped onto stockpiles with great effort. The next generation was endless rope haulages with side tipper cars stockpiling in the same way except with a lot less effort. The next generation stockpile was brought about by the introduction of belt conveyors. This was the opportunity to form conical stockpiles at the end of a boom conveyor. Mineral processors were immediately faced with the problem of raw material degradation due to the dropping at height from the end of the conveyor boom. They duly designed the luffing conveyor, suspended from an A-frame straddling the stockpile which ensured the gentle placing of material onto the stockpile. This was the first attempt at enhancing the stockpile design without it being driven by a development in the transportation method.

It soon became apparent a conical stockpile could not provide enough capacity and circular stockpiles were formed from the same conveyor boom. A number of these are still operating successfully on modern plants. Circular stockpiles have a capacity limitation and longitudinal stockpiles formed by gantry conveyor serviced by a traversing tripper car was developed. This latter development drops the material from a fixed height with the consequential degradation of material. Again the designers came to the rescue with the development of the traversing stacker conveyor which is equipped with a luffing boom to place material gently onto a longitudinal stockpile.

Reclamation methods were largely dictated by the shape of the stockpile and available reclamation technology. The first mechanisation of reclamation systems came about when mechanical front-end loaders appeared on the scene. These were used to reclaim from the side of a stockpile, transporting the material to a feed bin. The introduction of conveyor belts revolutionised the reclamation systems. Suddenly a variety of options were available to designers. Two main directions were followed, namely reclaim conveyors in tunnels under stockpiles and reclaim conveyors along the length of stockpiles. Extraction from the centre of a conical stockpile resulted in dead material around the edges which influenced the development of the inverted cone stockpile which ensured that no 'dead' material remained on the stockpile.

Feed systems were enhanced to eliminate material blockages and ensure a smooth feed to plant. These included opening up of the throat of the conveyor feed chute and introducing control measures like chain and finger controls and subsequently mechanical feeders. The same design evolution was applied to tunnel extraction systems under longitudinal stockpiles with the only further development being a plough extracting via a continuous slot under the stockpile to ensure the total extraction of material from the pile.

Running a conveyor along the length of a stockpile on surface allowed for the provision of reclamation bins along the length of the conveyor which minimised the distance travelled by mechanical loaders.

The next generation entailed the running of the conveyor immediately next to the toe of the stockpile with a ramp extending from under the stockpile to the edge of the conveyor immediately above the belt. Bulldozers were now able to doze material over the edge of the ramp directly onto the conveyor belt, thereby improving the reclamation rate, but pulverising the plant feed material.

The obvious development from this, to eliminate material degradation, was the introduction of scraper reclaimers in the form of bridge or portal reclaimers. An alternative to scraper reclaimers was also developed, namely the bucket wheel reclaimer which did away with the reclamation ramp by placing the material via a boom conveyor directly onto the main gathering belt. It was then just natural for the bucket wheel to be fitted to the stacking conveyor which was made reversible to act as a dual purpose machine.

This, in broad terms, is where we are today.

Adding Value to the Process

Whilst it is true that stockpiling adds cost to the mineral process in the form of additional capital cost, increased working costs and increased working capital, it will also be recognised that the provision of surge capacity in the form of stockpiles before and after a mineral processing plant, has the value of maximising plant throughput by ensuring the availability of raw material and product tipping space whenever the plant is available to run. One would think that the availability of a surge stockpile also ensures elimination of surges in the plant feed; however, certain reclamation systems have the tendency to reclaim in surges which have to be smoothed via a surge bin before the plant.

The raw material feed stock to a mineral process plant does not have a consistent quality. Plant processes can simply not be adjusted frequently enough to take care of variation in feed stock quality. The result is considerable loss of product yield. Stockpiling in the form of chevrons or beads which in turn are reclaimed across the end of the stockpile ensures effective blending of the raw material feed stock to the plant. This ensures a consistent feed of quality to the plant, thereby optimising product extraction yields from the process.

Selection of Stockpile Systems

Factors to be considered when selecting a stockpiling system are therefore:

- optimum storage capacity determined through modelling
- stacking and reclamation rates requirements
- process batching requirements
- blending requirements
- effect of degradation of plant feed stock as well as product degradation
- environmental effects on the mineral (moisture and oxidation)
- pollution hazards through wind and wash aways
- environmental hazards to the stability and safety of the equipment
- financial justification

Conclusion

The value added to the mineral process by the effective employment of stackers and reclaimers is therefore found in two main areas, namely the provision of surge capacity to ensure continuous smooth feed to plant and the effective utilisation of the blending facility provided by stockpiling and reclamation equipment. In addition to this, effective moisture drainage has been achieved from stockpiles.

The added value is affected by right sizing of the stockpiles and careful selection of system and equipment. The bottom line, however, is a careful financial evaluation of the proposals to confirm that stockpiling in fact has value for a particular mineral process.