Considerations for Selecting an Open Top Anode Baking Furnace Relining Strategy

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Abstract

Anode baking furnaces are designed to operate for many years. Whether due to end of life wear or anode dimension changes, furnace relining causes a major disruption to the production of carbon anodes in an aluminum smelter. There are several options available when it comes to determining when and how to approach this critical event. Anode production can be stopped over a prolonged period of time to allow for a complete open top furnace reline, a furnace can be relined one tub at a time to allow for production to be partially maintained, or one fire can be extinguished in order to reline a few furnace sections while maintaining anode production.
This paper covers the different elements that should be taken into consideration before selecting a specific rebuild method. Project drivers, planning, logistics, refractory design and capital costs are just a few of the issues that must be evaluated. Although the decision may not be obvious at first, a comprehensive engineering and construction analysis can ensure that the best business strategy is retained

Keywords: Open top anode baking furnace; furnace reline; anode production; refractory design and installation; firing cycle.

1. Introduction

Anode Baking Furnaces (ABF) are one of the most critical equipments operated in an aluminium smelter and can generate high operational expenses. In order to reduce smelter costs, anode production has to aim for quality and process consistency [1]. A well operated and maintained furnace can produce consistent quality anodes for the potlines, while minimizing carbon sector costs such as anode reject rates, refractory maintenance and energy consumption. Consistency is the key in maintaining high current efficiency in the pots where every anode effect impacts production costs.

However, the furnace condition deteriorates over time, due in part to the baking process itself (thermal cycling, chemical attack of the refractory, etc.) and plant operations (baking cycle time, firing system, sodium content, maintenance, etc.). The equipment's end of life may occur when anode quality begins to deteriorate, when energy consumption increases or when refractory maintenance costs are too high.

When a smelter decides that it is time to renovate the baking furnace, many factors should be taken into consideration. A furnace can be relined in the same manner it was built, keeping the same design and material specifications. A furnace can be raised to allow the production of longer anodes. A new furnace design may be considered to allow a change in anode dimensions or to compensate for previous changes. In this case, the entire refractory design may be modified, upgrading to thinner tub insulation with superior insulating materials, changing the fluewall arrangement to improve thermal distribution and improving the overall energy efficiency of the furnace. Ultimately the decision to reline, raise or redesign will have an impact on the shutdown strategy selected.

2. Planning

The key to success for any ABF reline project is proper planning. These types of projects are generally cost or schedule driven, which are they themselves affected by many other variables as shown in Figure 1 below.

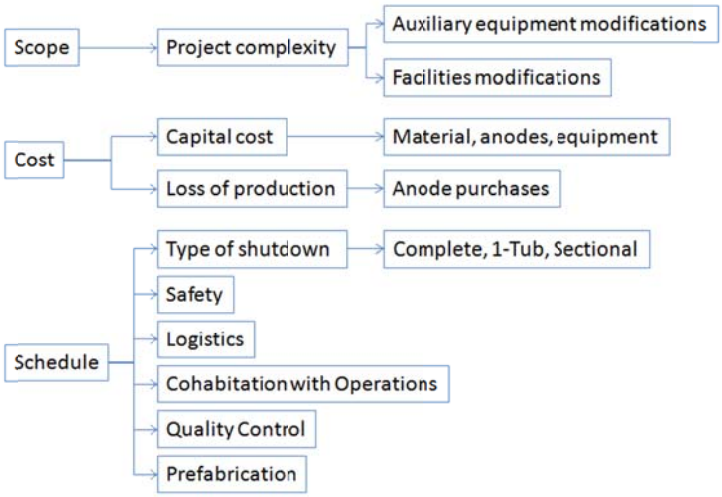

Figure 1. Variables affecting project drivers

During the engineering phase, coordination with operations, maintenance, and even the contractor will allow project management to properly define the roles and responsibilities of all participants. With ongoing production, there can be significant health and safety risks that must be identified with mitigation plans put in place. Lines of communication, priorities, rules and expectations to name a few, must be established early on in the project. All of these activities can only be achieved with the collaboration of all vested parties.

Logistics is another item that requires proper planning. Understanding the material requirements, especially the types of material used, the location in which they are needed and at what point during the reline, will allow the project team to determine a supply chain methodology that will help optimize the schedule. Additionally, proper shutdown planning will allow the project team to define the equipment required to handle material, if temporary storage is required on-site or offsite with respect to material delivery and schedule.

Demolition and installation strategies have to be properly identified in order to avoid delays during construction and determine the best shutdown approach. Crane utilization is amongst the most critical issues to deal with during a shutdown. Using innovative techniques for material handling to reduce crane dependence can significantly save time. Additionally, modeling individual tasks can help determine activity bottlenecks down to a specific hour, location or task. Figure 2 below shows an example of one of the exercises used to plan the different tasks carried out during a furnace shutdown. The figure is a snapshot of the complete exercise and the images selected represent three specific days where operation, demolition and construction activities had to be carefully coordinated to avoid any accidents and prevent shutdown delays

8. Conclusion

When a smelter decides that it is time to renovate the baking furnace, many factors should be taken into consideration. These types of projects are generally cost or schedule driven, and are affected by many variables such as project complexity, anode purchase, logistics, safety, quality control, labor requirements and cohabitation with operations.

Regardless of the shutdown strategy chosen, the key to success for any baking furnace reline project is proper planning. A well-defined engineering study needs to be carried out before the commencement of any shutdown activities. During this phase, coordination with operations, maintenance, and even the contractor will allow project management to properly define the roles and responsibilities of all participants. Modeling demolition and installation tasks can help determine activity bottlenecks down to a specific hour, location or task.

9. References

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