Packing Material in Carbon Baking Furnaces

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Abstract

Most carbon baking furnaces, open and closed top, use carbon-based packing material to support carbon blocks in the furnace pits. Care should be taken to select best suited material and maintain packing material in baking furnaces correctly. Degradation of carbon material sources gives new challenges to deal with, like increased packing material consumption and workers' health issues. Solutions are available, but should be selected according to plant situation. Ideas for improvement may be applied to solve old and new issues. This paper discusses the purpose, selection, maintenance, problems and solutions as well as ideas for improvements of packing material usage in carbon baking furnaces.

Keywords: Carbon baking furnaces; Packing material, Degradation of packing material.

1. Introduction

Depending on plant, baking furnace packing material can receive from no attention at all to a lot of attention. There are different packing materials available and they should be selected according to purposes to be met in baking furnaces. Once introduced in a baking furnace, packing material should be maintained, because most of it is recycled over and over, so a problem left at one time is a problem that may grow with time.

Some known packing material sources, like calcined petroleum coke, degrade with time. This leads to problems unknown a few years ago, that grow unnoticed for a while, until they become impossible to miss. One of them is a health issue for workers in baking furnace.

A good understanding of packing material, its use, its maintenance and problems that may be encountered is required to avoid carbon blocks defects, excess packing material consumption and operation problems.

2. Purpose

Packing material in baking furnaces has many purposes:

- Sustains carbon blocks mechanically during baking when binder softens while temperature rises;
- Allows optimal heat transfer from flue walls to carbon blocks;
- Allows volatile gas transfer from carbon blocks to flues;
- Blocks infiltration of air though packing material;
- Oxidises preferentially, to protect carbon blocks themselves from oxidation.

Packing material in baking furnaces should not:

- Shrink with temperature;
- Contaminate carbon blocks;
- Contaminate environment;
- Be harmful to people.

2.1 Support of Carbon Blocks During Baking

Packing material should flow freely around carbon blocks to be able to fill voids between carbon blocks and on carbon blocks themselves to sustain them. This implies that angle of repose of packing material should be quite low. Generally, angle of repose becomes larger with a reduction of particle size. Large particles have low angle of repose (Figure 1). Small particles and dust, have a high angle of repose. Particle shape also has an effect. Round particles flow more freely than irregular-shaped particles.

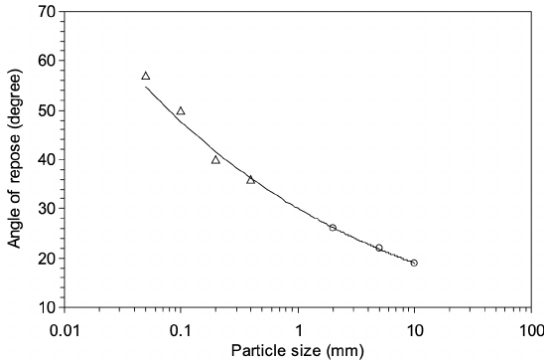

Figure 1. Angle of repose of granular material, example.

Problems involving insufficient support are: carbon blocks slumping, carbon blocks curving (carbon blocks which are close to the flue walls) and paste decompaction in specific block positions like middle of corners of carbon blocks and part of stud holes (Figure 2). Large decompacted paste chunks may sometimes detach from carbon blocks and cause other problems, like blocking packing material witdraw pipe or block advances on roller conveyors, by getting stuck between rollers.

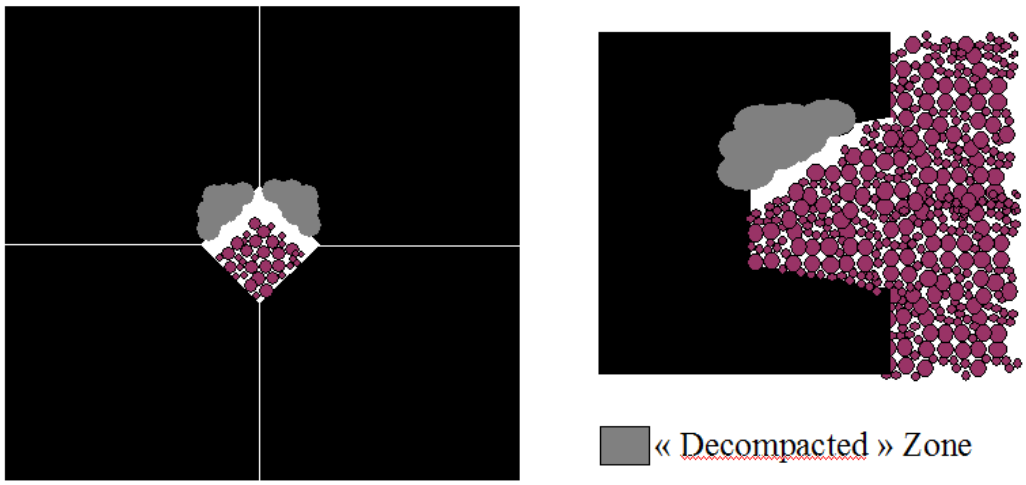

Figure 2. Blocks corners and stud holes decompaction caused by defective packing support.

2.2 Heat Transfer to Carbon Blocks

Heat transfer depends on many factors:

- Density of particles; higher is better, because higher density particles have better thermal conductivity;
- Particles size; bigger is better. So fine particles are to be avoided. (Figure 3, from Reference [1])

from insufficient butt cleaning, may result in low melting point ash. This is more likely to occur in closed top baking furnaces, because ash chunks form by packing material oxidation under the cover. Low melting point ash may also fill expansion joints and block sliding of flue walls in expansion joints, causing flue walls bending.

Packing material sticks to flues because of volatile gas carbonization in this material [6]. Removing fines may be a first step to reduce this problem. Keeping degassing slots clean may also help, because blocked degassing slots have the same effect as fine material. Consequently, volatile gas is left in a very hot environment, where it may transform to coke. This occurs in absence of air to burn the carbonised volatile since oxygen exists only inside flues walls.

5. Conclusion

Keep packing material coarse. It only has advantages. The only problem, in open top furnace, is that coarse packing material allows air infiltration from top of pits.

To counter this problem, use ways to block air infiltration: plastic sheet, tarp, aluminium foil. Or invent an open top furnace pit cover, similar to closed top furnace cover. Or use fine packing material on top of pit only.

Limit air oxidation of packing material. Lower air oxidation catalysts level when it is possible to do it. Or use ways to counter catalysts. Lower air static pressure in cooling sections, to limit reheat from packing material oxidation, that slows down cooling process, and useless waste of packing material.

Packing material is not only a consumable in baking process. It is an important actor in baking process itself. It should not be neglected.

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