REFRACTORY RESISTANCE TO CARBON MONOXIDE (CO) DISINTEGRATION ATTACK

Chemical attacks on refractories are mainly caused due to slags, gases like carbon monoxide (CO), and glasses etc. The test of determination of resistance of refractories to Carbon Monoxide (CO) disintegration is very important for fire clay bricks used in blast furnace stacks and other furnaces where CO is encountered, as in carbide manufacture and in carbonization of coal.

Depending on their composition, many refractories may begin to deposit carbon when exposed to a Carbon Monoxide (CO) atmosphere over a certain range of temperature and period. The dissociation reaction takes place as follows (Bell's Reaction):

$2CO = CO_2 + C_{(soot)}$

Any form of iron present in the refractory acts as a nucleation site for deposition of Carbon. This is one of the most common and possible factors including disintegration of blast-furnace linings where disintegration is caused by deposition of soot carbon as a result of Bell's Reaction.

Test of Resistance to CO (Carbon Monoxide) Disintegration [in Brief]

The mechanism of carbon deposition on refractory pores is technically known as VLS (vapour - liquid - solid) mechanism. The various test methods for verification of **Resistance of Refractories to Carbon Monoxide (CO) Disintegration** are BS 1902-3.10, ISO 12676, ASTM C288-87 (2009) etc. These test methods are used to determine the relative resistance of different type of refractories to disintegration caused by exposure to CO (Carbon Monoxide) atmosphere. The results obtained by these methods can be used to select refractories that are resistant to CO

disintegration (attack). There are both qualitative and quantitative methods of testing although the standard method is for qualitative tests only. It comprises selection of two refractory test specimens. One of the test specimens is cut fro the center of a refractory and the second specimen is cut from the exterior of another refractory shape. The specimens so cut are of cylindrical shapes of 50 mm length and not less than 30 mm diameter. The refractory specimens may also be cut to rectangular or prismatic shapes. The two refractory specimens are placed in a wire-wound furnace of a suitable size which is purged with purified nitrogen. The furnace is heated to $450^{O}C$ and purified CO is then allowed to pass through the furnace at the rate of 2 liters per hour. The test is continued for 100 hours or until the test specimens (refractories) disintegrate if it occurs earlier. The test specimens therefore, should be examined at regular intervals of time for discoloration, carbon decomposition and disintegration that may take place during the course of test. The entire test is to be carried out over a range of temperature under a constant supply of carbon monoxide. The time after which carbon deposition and disintegration takes place is taken as a measure resistance of the refractory to CO (Carbon Monoxide) attack. Purification of CO (Carbon Monoxide) and nitrogen is carried out to remove carbon dioxide, oxygen and water vapour.

Effect of CO (Carbon Monoxide) Attack on SiC and SiN Refractories

Here it would not be irrelevant to discuss about one report of former Ukrainian Scientific Research Institute of Refractories according to which, SiC (Silicon Carbide) is destructed most rapidly at $1200^{O}C$ while Silicon Nitride (SiN) virtually do not change on heating up to $1400^{O}C$ in presence of CO. At $1200^{O}C$ Carbon Monoxide (CO) and alkalies significantly influence the property variation of the Silicon carbide refractories (SiC) containing a SiN-based binder only during first 2 hours of holding, which was confirmed by abrupt decrease of the open porosity and

the apparent porosity during this period. Further increase in the holding period up to 16 hours does not above a significant change of the properties of the products owing to the protective glassy coating formed on the refractory surface as a result of partial oxidation of SiC. According to thermodynamic data given in the above report, when Silicon Carbide (SiC) is heated in CO the most probable reactions include -

$SiC + CO = SiO + 2C$,

$SiC + 2CO = SiO_2 + 3C$,

$SiO + C = Si + CO$.

Source : http://viewforyou.blogspot.in/2009/11/refractory-resistance-to-carbon.html