PROPERTIES OF CARBON GRAPHITE MATERIALS FOR SEAL RING APPLICATION

G. Rinn, R. Wolf
Schunk Kohlenstofftechnik GmbH, P. O. Box 10 09 51, D-35339 Giessen

Introduction

Typical carbon graphite materials for seal ring applications are produced from mixtures of special graphites carbon black and cokes in a matrix of coal tar pitch. The mixture is milled to a well defined particle size distribution, pressed into shapes and heat treated in a non-oxidizing atmosphere to convert the pitch into coke.

The paper deals with the influence of maximum temperature of the baking process and the influence on the structure on the coke matrix and, therefore, on the performance in seal ring applications.

Experimental

Two typical formulation for seal ring applications (grade A, B) were used to produce sample plates of about 120 x 70 x 30 mm according to the above mentioned procedure. All plates were heated up to 900 °C and then, divided into different sub groups, post baked to 1200 °C, 1500 °C and 1800 °C.

The samples were analyzed using standards according to DIN or ISO with respect to the following properties: bulk density, porosity, flexural strength, BET surface area, chemical composition (S, O, H, N), thermal conductivity, oxidation resistance, water absorption and dimensional stability.

Results and discussion

The most pronounced observation was the presence of micropores in the pitch coke matrix after baking to 900 °C and their disappearance due to structural rearrangement at temperatures above 1200 °C. Almost all other properties of the materials are directly influenced by this process.

From 900 °C to 1200 °C the open porosity drops by 5 - 7 % by volume (fig. 1) and the BET surface area from 10 - 20 m^2/g to 2 - 3 m^2/g. At 1800 °C it is reduced to < 1 % (fig. 2). The change in porosity and surface area is accompanied by increasing strength (appr. 20 %) and thermal conductivity (> 100 %). The concentration of all non-carbon elements in the material decreases. Especially the oxygen content is very close related to the disappearance of the micropores (fig. 3). This observation indicates the influence of cross linking of the pitch by oxygen onto the generation and/or the temperature of disappearance of the micropores.

Two important properties for seal ring applications are directly influenced by the structural rearrangement, too: The oxidation rate at 400 °C in air drops from 0.25 - 0.40 %/h to < 0.01 %/h (fig. 4), and the water absorption after 24 h in 100 % relative humidity at ambient temperature from 1.5 - 2.5 % to < 0.05 % (fig. 5). The dimensional change caused by water absorption and swelling is reduced from 0.1 - 0.2 % to < 0.02 %.

Conclusions

Carbon graphite materials for seal ring applications should be baked at temperatures ≥ 1200 °C. Otherwise, the oxidation resistance will not be sufficient for high temperature applications. In wet applications the water absorption into the micropores causes swelling and, therefore, distortion of the seal ring and leakage of the seal.

References

1. Rinn, G. and Klatt, J., in Ext. Abstr. 50th Annual Meet. STLE, Chicago, III, 1995

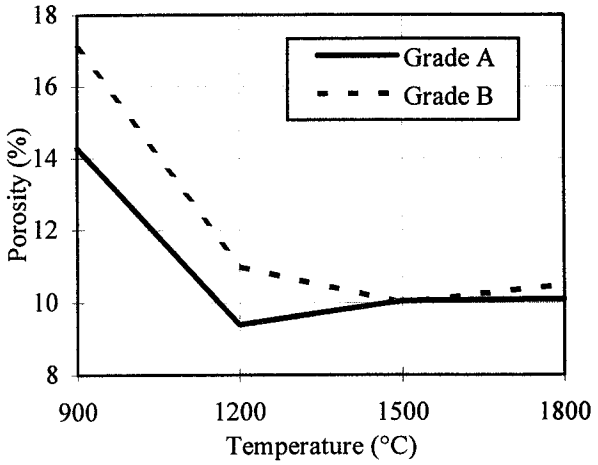

Figure 1. Open porosity vs. baking temperature

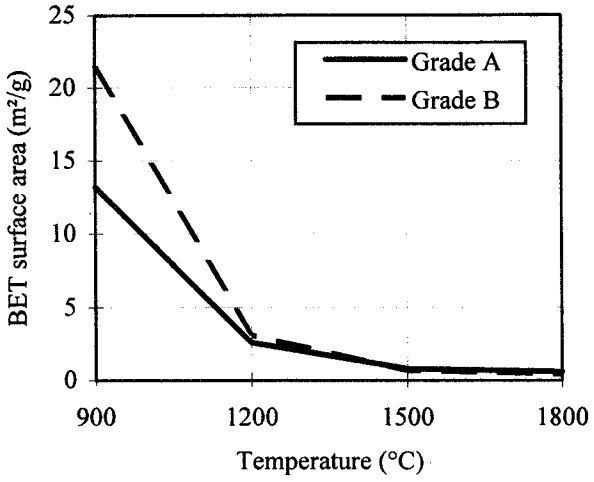

Figure 2. BET surface area vs. baking temperature

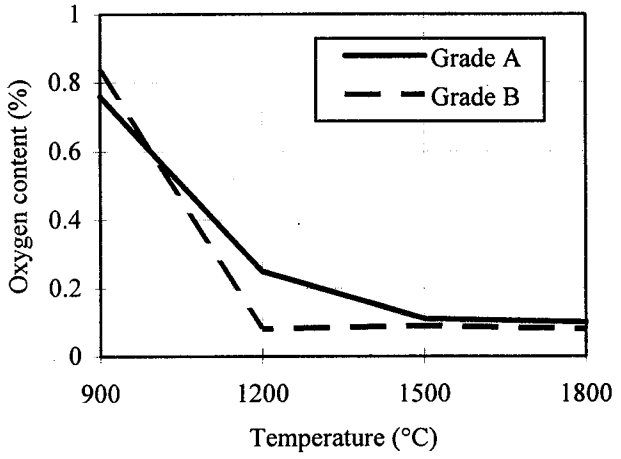

Figure 3. Oxygen content vs. baking temperature

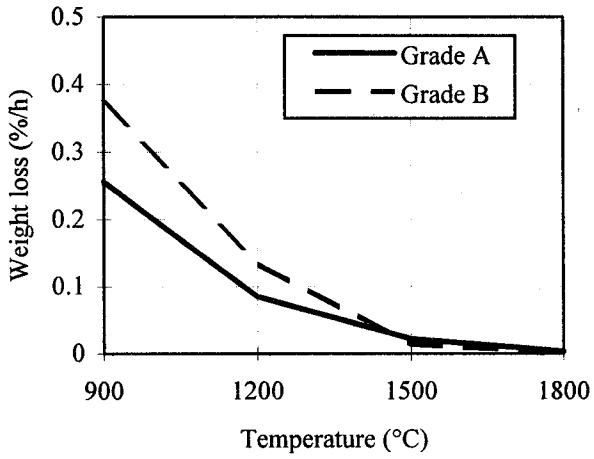

Figure 4. Oxidation rate at 400 °C in air vs. baking temperature

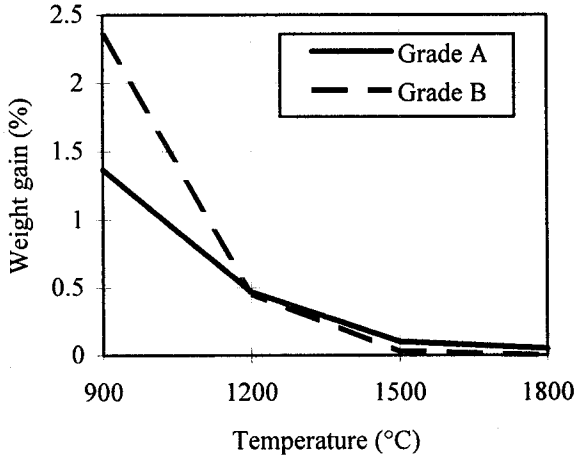

Figure 5. Water absorption at 100 % relative humidity and ambient temperature vs. baking temperature