

(212)

On the Thermal Diffusivity of Sponge Iron^{*1,2)}

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1. Introduction

To describe the melting of sponge iron in a furnace, the thermal diffusivity α has to be known. Until now there exist no measurements over the whole temperature region from 20-1400°C.

2. Measurements of thermal diffusivity

The thermal diffusivity is measured by the laser flash method (1). The sample is made of pressed ground sponge iron, with nearly the same physical properties as sponge iron. The thermal diffusivity of sponge iron at 20°C is nearly 1/10 that of pure iron (Fig.1).

With rising temperature the diffusivity increases. The same discontinuity at the Curiepoint is observed as in pure iron.

3. Model for the different thermal diffusivity of sponge iron

For low temperatures Fig. 2 shows a model of sponge iron, consisting of iron spheres with a small "heat bridge" between the spheres.

A simplified computation model (1, 2), shows that the thermal conductivity

$$\lambda = \frac{\lambda_2/\lambda_1 - 1 - \ln(\lambda_2/\lambda_1)}{(1 - \lambda_2/\lambda_1)} \cdot 2 \lambda_2$$

λ_1 = thermal conductivity of pure iron
 λ_2 = thermal conductivity of gas

is about 0,5% that of compact pure iron. For higher temperatures scanning electron micrographs show that the "heat bridges" and hence the thermal diffusivity of sponge iron increase due to sintering.

4. Heating of a cylinder with $\alpha = \alpha(\vartheta)$

Fig. 3 shows the comparison of the observed and calculated temperature change of a sponge iron cylinder during heating.

It is possible to describe the heating up of sponge iron more exactly using the thermal diffusivity mentioned in this work.

References:

- 1) Gudenau, H.W. et al.: Arch. Eisenhüttenwes. 52 (1981) p. 261/64
- 2) Rademacher, P.K.: Dr.-Ing. thesis RWTH Aachen, to be published
- 3) Beer, P.: Techn. Mitt. Krupp, Forsch.Ber. 21 (1963) p. 120/22

Fig.3: Comparison of the measured and calculated temperature change of a sponge iron cylinder

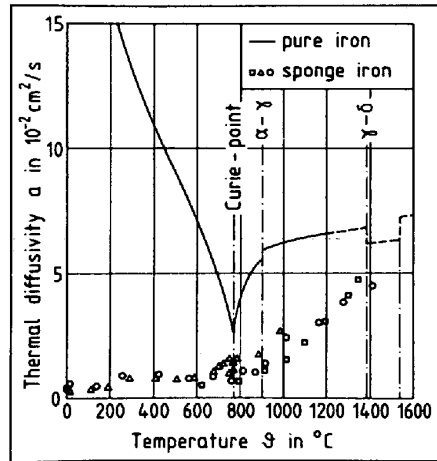


Fig.1: Thermal diffusivity of pure iron and of 3 equal samples of sponge iron (2)

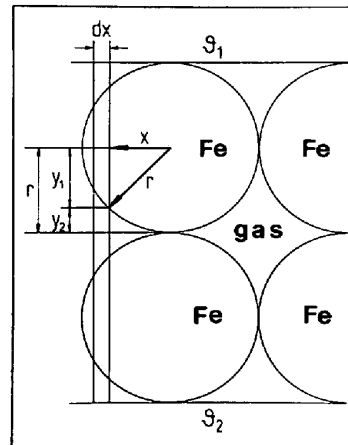


Fig.2: Model of sponge iron having an unfavourable structure for heat conduction

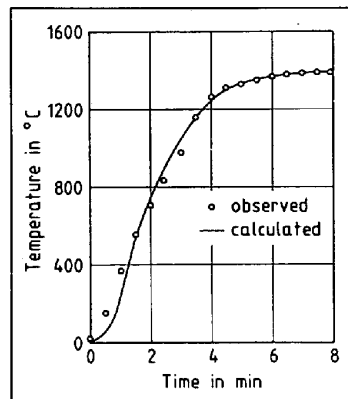


Fig.3: