NEW APPLICATION FOR FLEXIBLE GRAPHITE SHEET

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Introduction

In recent years, flexible graphite sheets made by compacting exfoliated or expanded graphite particles has become useful for a wide range of applications (1). The outstanding properties of flexible graphite were recognized at a very early stage (2). Sheets of flexible graphite having the same chemical and thermal stability as other graphite grades are well suited to protect other materials against chemical and thermal corrosion. Their flexibility enable their adaption to nearly every contour and their low permeability provides a good seal against fluids. A valuable property for some applications is also the anisotropy of the sheet (Table I).

Thermal insulation

Flexible graphite sheets are especially suited for radiation shields (3, 4). The radiation shields shown in Fig. 1 are efficient high temperature insulators. In comparison with heating shields made from molybdenum graphite sheets are cheaper, easy to handle and its weight is comparatively low. For the insulation of vessels carrying a cyrogenic fluid it is advantageous to provide the graphite sheet with a thin, highly reflective metal coating, such as aluminum, gold, silver or copper (3).

Surprisingly, flexible graphite sheets are very suitable for irradiation shielding against continuous and pulsed laser radiation. Perforating a 0,1 mm thick sheet with a continuous carbon dioxid laser takes about 3 seconds for instance. Sheets of 2 mm thickness could not be perforated with the same laser equipment the power output of which was 100 W with a focal point diameter of about 1 mm. Even a ruby laser furnishing a pulsed energy of 40 kW could not perforate sheets of 5 mm thickness. After irradiation only small bubble shaped bulges were observed at the surface of the sheet (5). Obviously the incident radiation energy is dissipated within the sheet, predominantly parallel to its surface whereby the density of the energy decreases below the vaporizing energy of carbon.

Chemical and metallurgical applications

Electrostatic precipitators used for the purification of gases containing acids, are often destroyed by corrosion especially the precipitating electrodes. By cladding the structural parts as well as the electrodes, any corrosion attack can be prevented. Fig. 2 shows the cross section of an electrostatic filter containing precipitating electrodes, which are clad with flexible graphite sheets (6). To avoid the corrosion of the discharge wire it is advantageous to make the wires from carbon or graphite threads (7). These electrostatic precipitators are used in plants for the combustion of garbage and in aluminum foundries in which the metal is refined using chlorine.

In foundries flexible graphite sheets are also used instead of black washes (8) and as liners for both pressing and casting moulds (9). The sheets are hardly wetted and therefore metal adherence does not occur. For hot pressing, flexible graphite sheets can be used simultaneously as heating elements and as liners. At high temperatures, normal cements are not suited for bonding the sheets to the mould and also carbonizeable binders are not always effective. In another method the sheet is welded with the aid of stainless steel welding rods (Fig. 3) (10). The most suitable method has to be established for each individual case, however.

Conclusion

Flexible graphite sheets are a valuable material in the chemical and metallurgical field and for thermal insulation.

References

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Table I

Properties of graphite sheets

bulk density g/cm^3	0,9 - 1,1
spec. electr. resistivity	
parallel to the surface Ω mm^2/m	8
perpendicular to the surface Ω mm^2/m	$4 \cdot 10^{-4}$
coefficient of anisotropy	5000
thermal conductivity	
parallel to the surface W/mK	175
perpendicular to the surface W/mK	3,5
coefficient of anisotropy	50
permeability (air) cm^2/s	$< 10^{-6}$
ash content %	0,002

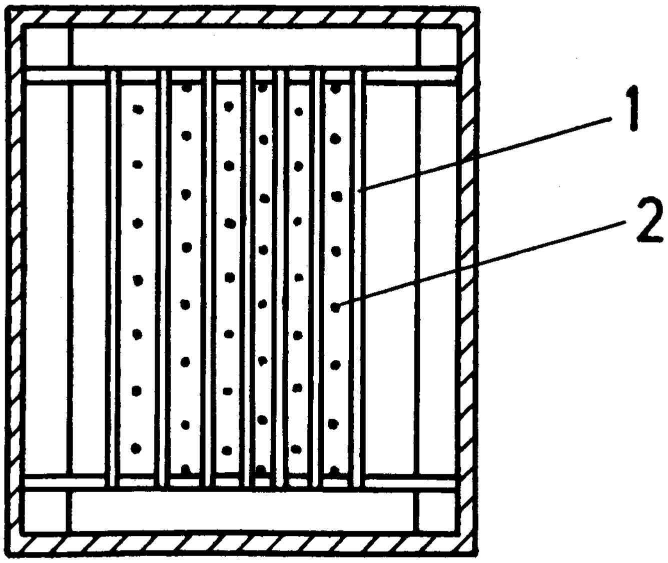

Fig. 2 Electrostatic precipitator;
1 - precipitating electrodes,
2 - discharge wires

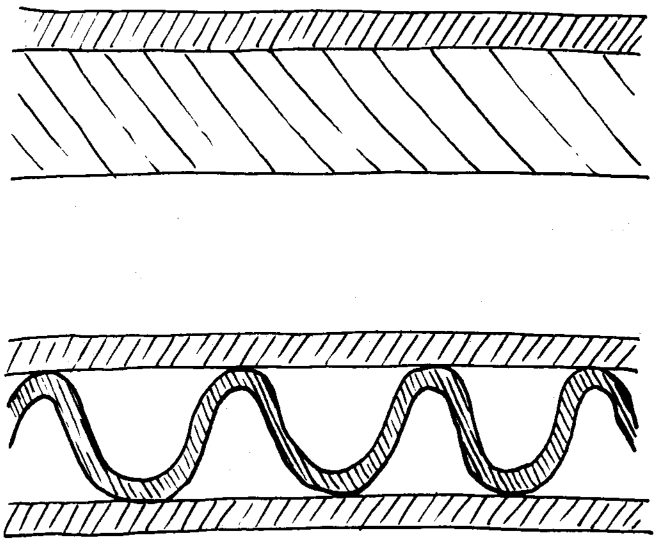

Fig. 1 Radiation shields

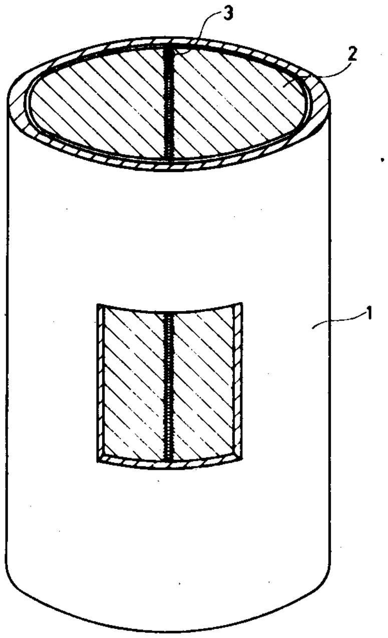

Fig. 3 Flexible graphite liner with welding seam;
1 - steel tube,
2 - flexible graphite sheet
3 - welding seam