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技术及应用

含硼矿物及环氧树脂复合材料的中子屏蔽性能

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摘要 以我国特有的含硼原矿经选矿和高炉分离后分别得到的含硼铁精矿粉和富硼渣为研究对象，用蒙特卡罗方法研究了二者及其环氧树脂复合材料的中子屏蔽性能，讨论了影响材料屏蔽性能的因素，确定了含硼矿物/环氧树脂复合材料合适的配比范围；得到了材料的快中子分出截面和热中子衰减系数，并与常用的混凝土屏蔽材料进行对比。结果表明：复合材料对14.1 MeV快中子的屏蔽性能主要与屏蔽材料中低原子序数元素的含量有关，含硼矿物复合材料对热中子的屏蔽性能与硼元素的浓度有关，伴生γ射线光子的衰减主要与矿物材料中高原子序数元素的含量和材料的密度有关。含硼矿物复合材料中含硼矿物的最优体积比为0.4~0.6；最佳配比对14.1 MeV快中子的屏蔽性能与混凝土的接近，对热中子的屏蔽性能强于混凝土的，有望作为辐射场周围混凝土屏蔽层的裂缝灌注及不规则孔洞的填补或直接制备复合屏蔽材料。

关键词 含硼矿物 环氧树脂 14.1 MeV快中子 热中子 蒙特卡罗方法

分类号

Neutron Shielding Properties of Boron-Containing Ore and Epoxy Composites

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Abstract Using the boron-containing iron ore concentrate and boron-rich slag as studying object， the starting materials were got after the specific green ore containing boron dressing in China and blast furnace separation respectively. Monte-Carlo method was used to study the effect of the boron-containing iron ore concentrate and boron-rich slag and their composites with epoxy on the neutron shielding abilities. The reasons that affecting the shielding materials properties was discussed and the suitable proportioning of boron-containing ore to epoxy composites was confirmed; the 14.1 MeV fast neutron removal cross section and the total thermal neutron attenuation coefficient were obtained and compared with that of the common used concrete. The results show that the shielding property of 14.1 MeV fast neutron is mainly concerned with the low-*Z* elements in the shielding materials, the thermal neutron shielding ability is mainly concerned with boron concentrate in the composite, the attenuation of the accompany γ-ray photon is mainly concerned with the high atom number elements content in the ore and the density of the shielding material. The optimum volume fractions of composites are in the range of 0.4-0.6 and the fast neutron shielding properties are similar to concrete while the thermal neutron shielding properties are higher than concrete. The composites are expected to be used as biological concrete shields crack injection and filling of the anomalous holes through the concrete shields around the radiation fields or directly to be prepared as shielding materials.

Key words boron-containing ore epoxy 14.1 MeV fast neutron thermal neutron Monte-Carlo method

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