Production of ultra-light weight steel foam

Hossam El-Din Abdallah Abd El-Gawad Morgan

Metal foams are cellular materials that have great strength-to-weight ratio and are used for applications ranging from mechanical to thermal.Recently, the research has been focused on a low costly material that is better than aluminum and has higher mechanical properties than it, it is steel.Open- cell metallic foams can be produced by slip casting. This method provides several advantages as it allows working at room temperature and thus lowers the instrumental outlay. To carry out the characterization of the steel foam, fine steel powder is mixed with dispersant, distilled water and concentrated phosphoric acid. Together with the metallic particles the phosphoric acid forms a binder on the base of a phosphate. After drying, the samples are sintered under defined conditions and thus an open- cell porous structure is received. In this work, foams made of the byproduct steel shots powder are used to produce steel foam by Slip Reaction Foam Sintering (SRFS) process. The production parameters as sintering temperature, amount of dispersant, binder, powder particle size, foaming agent, solvent and sintering time are varied. The influence of these parameters on the foam properties as density, porosity, microstructure, and mechanical properties are evaluated and discussed.The pore structure is characterized by the determination of the foam steel densities and optical evaluations. A relative low density ranged from 2-3 g/cm3 could be achieved for produced steel foam. The mechanical properties of metallic foams produced by slip casting tested by means of static compression tests. The percent of the shrinkage occurring after sintering is approximately from 25-38 %, also the compression strength increased as the densities increased. The strength is approximately ranged from 15-39 MPa.Both the laminate silicate and starch have the same behavior in effect on the properties.More control on sintering atmosphere should be considered. Extra carbon should be added and optimized to avoid the loss of carbon content due to decarburization through sintering process.The effect of heat treatment on the final properties of steel foam was evaluated. Normalizing at different temperature (800, 850 and 900 °C) was applied. It is found that increasing normalizing temperatures is accompanying by increasing compression strength from 7MPa to 13 MPa.