

Thermal Shock Resistance Investigation of Evaporation Boat Waste-based Crucibles

Rusiyanto^{1, a)}, Febri Budi Darsono^{1, b)}, Hidayat Noer Rifki Supriyadi^{1, c)}, Deni Fajar Fitriyana^{1, d)}, Wirawan Sumbodo^{1, e)}, Ari Dwi Nur Indriawan Musyono^{1, f)}, and Januar Parlaungan Siregar^{2, g)}

¹Department of Mechanical Engineering, Universitas Negeri Semarang, Sekaran, Gunung Pati 50299, Semarang, Indonesia

²Faculty of Mechanical and Automotive Engineering Technology, Universiti Malaysia Pahang Al-Sultan Abdullah, 26600 Pekan, Pahang, Malaysia

^{a)}Corresponding author: me_rusiyanto@mail.unnes.ac.id

^{b)}febribudi@mail.unnes.ac.id

^{c)}hidayatnurrifki@gmail.com

^{d)}deniifa89@mail.unnes.ac.id

^{e)}wirawansumbodo@mail.unnes.ac.id

^{f)}ari.kecil@mail.unnes.ac.id

^{g)}januar@ump.edu.my

Abstract. A crucible is a container shaped like a pot or a bowl used for smelting non-metallic materials, quality of the crucible can be influenced by several factors, including the selection of the constituent materials, the particle size used the amount of compaction pressure, and the length of firing time in the furnace. The selection of constituent materials is done by selecting the crucible-making mixture. The use of crucibles is for pyrometallurgical processes used for gold processing. Waste is closely related to pollution because this waste is the substance of environmental pollution therefore, waste treatment is needed so that it does not pollute the environment, the principles of solid waste management are prevention, recycling one example of solid waste is evaporation boats. Evaporation boats are included in one of the refractory materials because the waste from evaporation boats contains boron nitride (BN) and titanium diboride (TiB₂) materials. So the purpose of this research *was to determine* thermal shock resistance of evaporation boat waste-based crucibles. The process of making specimens begins with crushing the evaporation boat waste with a crusher machine *into powder*, then sieved using a 120-mesh, then mixed with graphite, kaolin, and molasses using a mixer for 90 minutes until homogeneous mixture. The mixed material is then cast using molds according to ASTM D256 standards and pressed or compacted with a compacting tool worth 40 MPa. The specimens were then dried in an oven for four hours at 100°C, after that, the specimens were sintered at 1000 °C for 2 hours with a heating rate of 4 °C/min. The Compositions evaporation boat waste, graphite, kaolin, and molasses (75%, 15%, 10%, 30%; 75%, 20%, 5%, 30%; and 75%, 25%, 0%, 30%) are the materials used. Thermal shock treatment temperatures range from 100°C to 200°C, 300°C to 400°C, and up to 500°C. The results showed the highest average value of impact resistance was in composition 3 (75%, 25%, 0%, 30%) with a thermal shock temperature of 100°C worth 0.00501 J/mm², and the lowest was in composition 2 (75%, 20%, 5%, 30%) at a thermal shock temperature of 500°C worth 0.00359 J/mm². The average impact resistance value for each composition decreases, which is followed by an increase in the thermal shock temperature, This is because the higher the temperature of the thermal shock, the harder the specimen becomes and the specimen becomes brittle, variations in evaporation boat waste, graphite, kaolin, and molasses as crucible materials will be better if the use of kaolin in these compositions has a low presentation, even the highest average impact resistance value is in compositions that do not use kaolin on specimen composition 3.

INTRODUCTION

Indonesia is a major gold producer in the world [1], one of the gold processing methods used is the metallurgical method, which uses the pyrometallurgical method using high temperatures. The hydrometallurgical method is a method that uses a solution combined with a chemical substance so that the gold ore will be released