Compression Moulding Technique for Manufacturing Biocomposite Products

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Abstract

Biocomposite products are combination between synthetic or natural polymers as matrices and natural fibers as fillers. The products can fully or partially degradable by biological means. The manufacturing biocomposite products can be done by using several techniques such as compression moulding, injection moulding, solution casting, and so forth. This paper discusses briefly the advantages of compression moulding and its procedures. The machines and tools that have usually been used for this technique were also demonstrated. In addition, the types of materials that utilized for manufacturing biocomposite samples were described. The biocomposite products that have been or will be in the market were also indicated. It can be concluded that the compression moulding technique is the best technique for manufacturing biocomposite products since it could mould large products and it also produces less waste compared with other techniques.

Keywords: Compression moulding, biocomposite product, hot press, natural fiber

Introduction

The use of compression moulding technique for manufacturing biocomposite products is quite interesting since it offers a fastest forming process compared to solution casting technique (Shamsuri and Daik 2012, Shamsuri and Daik 2013, Shamsuri et al. 2012). This technique also one of the lowest price moulding processes compared with other processes for instance injection moulding, and so on. Furthermore, this technique also discards relatively small waste, thus providing benefit when moulding with other costly materials. On the other hand, compression moulding technique is suitable for high pressure manufacturing process and also appropriate for moulding complex natural fiber reinforced polymer biocomposites. Other good things of compression moulding technique are it capable to mould extra large and complicated components in comparison with the injection moulding technique.

Method

In our previous studies, we have developed polymer blend and polymer biocomposite samples through compression moulding technique by means of a hydraulic hot press machine. The technique involves three steps of procedures specifically: (1) Preheating samples at specific temperature for certain times to soften them. (2) Compressing preheated samples at the same temperature to match to the mould shape. (3) Cooling compressed samples under pressure for particular intervals to cool the samples (Shamsuri and Daik 2015, Shamsuri et al. 2009, Shamsuri et al. 2014, Shamsuri et al. 2015). Nevertheless, the appropriate heating method and the necessitated force must be determined first, this may avoid deterioration of biocomposite materials. Moreover, this technique sometimes requires internal mixer or extruder to blend between polymer matrix and natural fiber in advance for enhancing the dispersion of the fiber used. Fig. 1 shows the photographs of internal mixer, hydraulic hot press machine, and sheeted mould with covers.

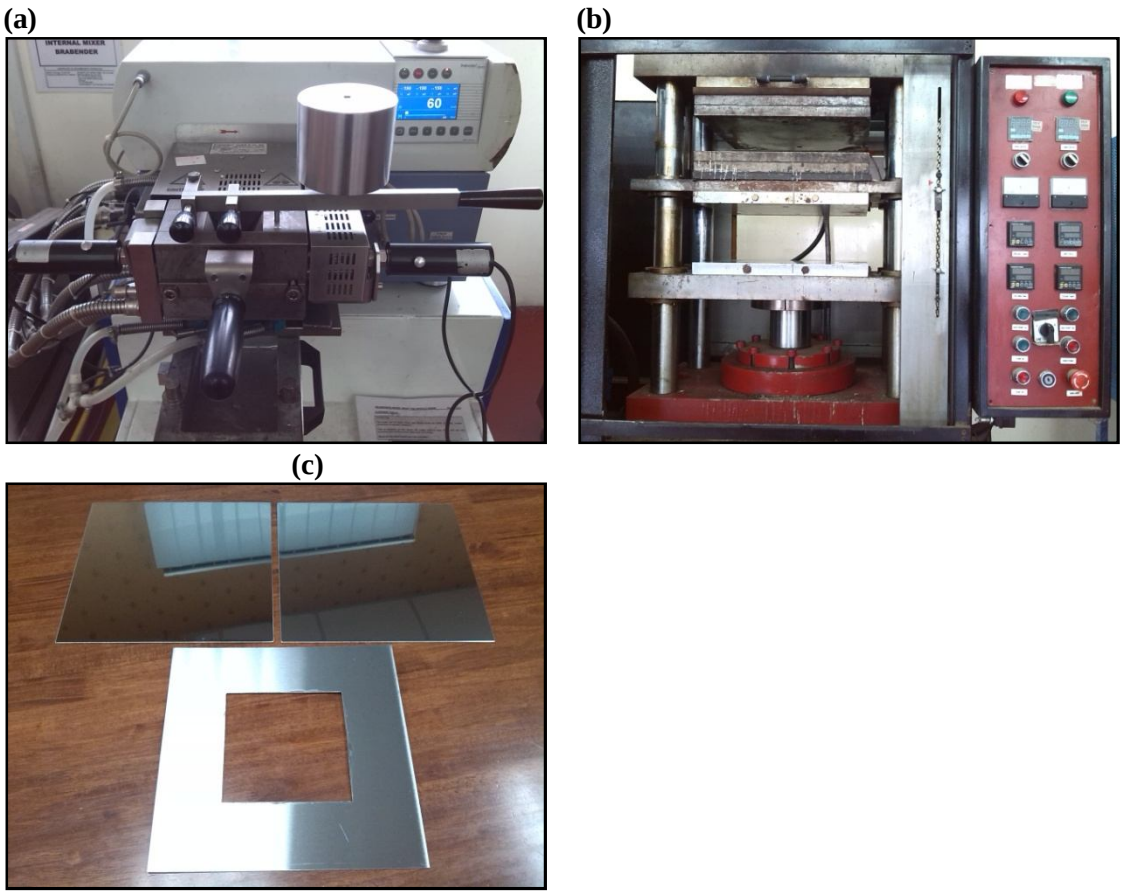

Fig. 1 Photographs of (A) Internal Mixer, (B) Hydraulic Hot Press Machine, and (C) Sheeted Mould with Covers

Materials

Matrix materials that are commonly used in compression moulding technique can be either thermoplastics, elastomers, or several types of thermosets. Thermoplastic such as polyethylene could also be compression moulded with randomly oriented natural fiber or natural woven to develop biocomposite samples (Shamsuri et al. 2014). Biocomposite materials can be loaded into the mould either in the form of bulk or pellets then they are heated above their melting points, formed and cooled. The proper amount of biocomposites and the minimum amount of temperature needed to heat them should be ascertained, this includes the minimum time required to mould the biocomposites. Fig. 2 indicates the photographs of blended HDPE/agar biocomposite, moulded HDPE/agar biocomposite, virgin LDPE and cellulose woven, and moulded LDPE/cellulose woven biocomposite.

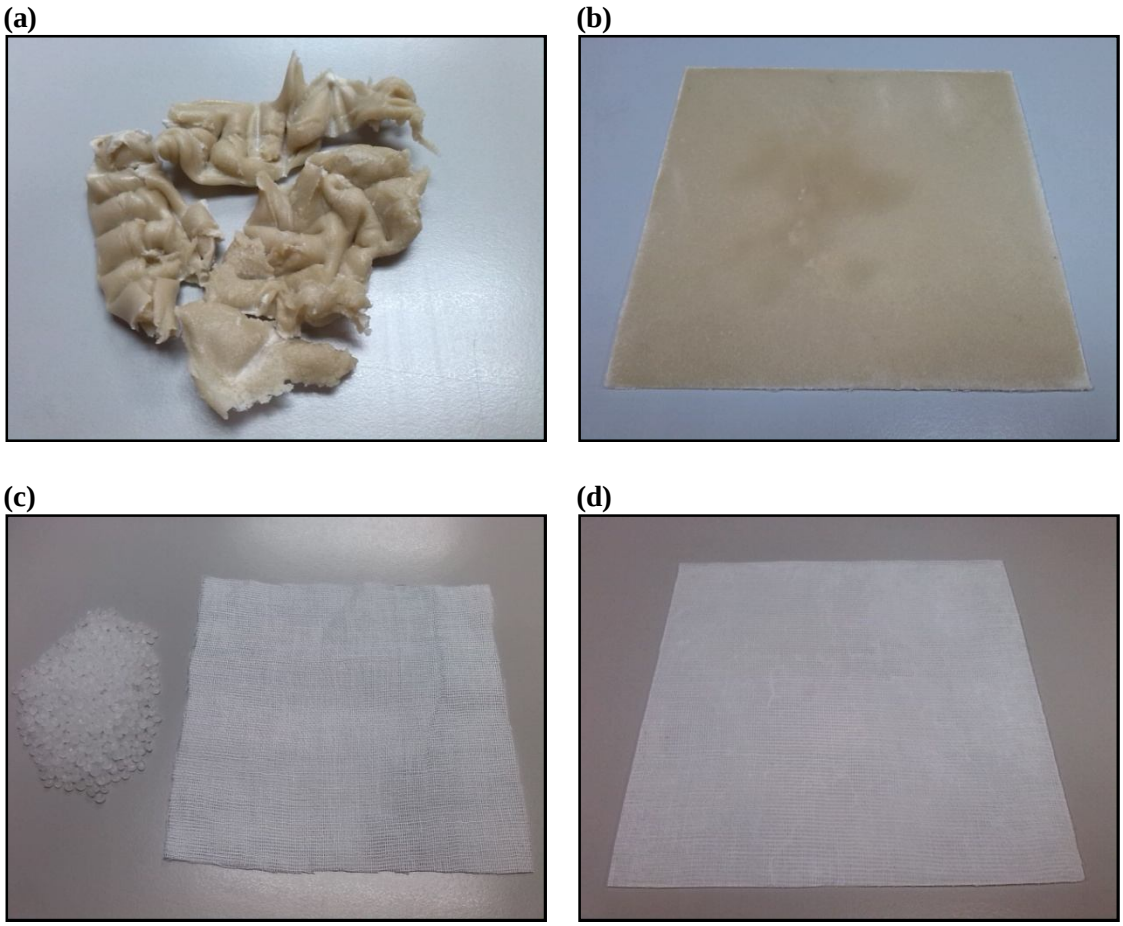

Fig. 2 Photographs of (A) Blended HDPE/Agar Biocomposite, (B) Moulded HDPE/Agar Biocomposite, (C) Virgin LDPE and Cellulose Woven, and (D) Moulded LDPE/Cellulose Woven Biocomposite

Products

The compression moulding technique is usually utilized for manufacturing crockeries, rubber boots, big containers, homewares products, etc. This technique of moulding is also really applied in fabricating vehicle parts, few significant example are spoilers, bonnet scoops, mudguards, and so on. Thermoplastic matrices have been commonly used for manufacturing biocomposites on a pilot scale, furthermore thermo set matrices in either granule or preform shapes have also been employed in this moulding technique to produce biocomposites. The materials are usually calculated and preheated prior to moulding compared with numerous of the other moulding techniques, this assists to decrease surplus waste. Fig. 3 exhibits the photographs of food container, safety helmet, and car component made from biocomposites that manufactured through compression moulding technique.

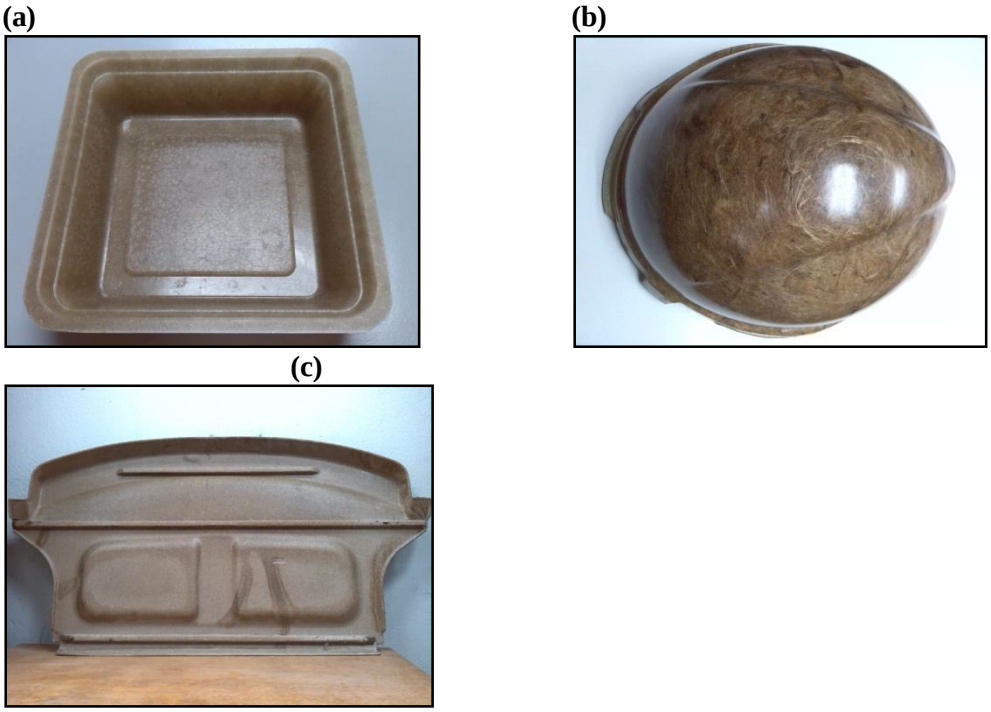

Fig. 3 Photographs of (A) Food Container, (B) Safety Helmet, and (C) Car Component

Conclusions

Combination between synthetic or natural polymers as matrices and natural fibers as fillers can produce biocomposite products. Fully or partially biodegradable character is the main feature of these products. Several techniques such as compression moulding, injection moulding, solution casting, and so forth have been used to manufacture biocomposite products. The advantages of compression moulding and its procedures have briefly been discussed in this paper. This technique also demonstrated the machines and tools that were usually used. Additionally, the utilization of materials in the manufacturing biocomposite samples was described. The compression moulding technique could mould large products and it also produces less waste compared with other techniques. In conclusion, the compression moulding is the best technique for manufacturing biocomposite products.

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