



Research article

Food packaging from recycled papers: chemical, physical, optical properties and heavy metal migration



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ABSTRACT

Paper recycling is a viable option for wastepaper management. This study assessed the suitability of recycled papers as a food packaging material. Permanence and durability of three different recycled papers; R1:150 GSM, R2:120 GSM, and R3:100 GSM with aging were evaluated using standard methods. Eventhough opacity increased with aging grammage, burst strength, tensile strength, pH, brightness, and whiteness decreased. Recycled papers failed water absorptiveness test even before aging. Presence of heavy metals in recycled papers were compared with food packaging standards and migration of heavy metals from the packaging to different food types was assessed. Presence of Cu, Zn, Mn, Cr, Cd and Pb were below EC and EPA standards but only Pb and Cd exceeded the EU standard. Migration of Cu, Zn, Mn and Cr were within EPA, EU and EC standards except Pb and Cd with respect to EC standard. Highest migration is associated with foods contain more fatty acids; fast food, sausages and pizza.

1. Introduction

According to global statistics, 2.01 billion tons of Municipal Solid Waste (MSW) is generated annually with an average per capita waste generation of 0.74 kilograms (kg). Per capita waste generation is expected to increase by 19% in high income countries while 40% or more in low- and middle income countries. Waste accumulation is estimated to be increased up to 3.40 billion tons by 2050 (The World Bank records IBRD.IDA, 2022). Therefore, solid waste management has become an alarming problem in both the developed and developing world (Abdel and Mansour, 2018). Different nations in the world face many social, environmental, and economic problems due to solid waste generation. Major components of MSW are food, plastic, metal, paper and paper board, rubber, leather, textile, and hazardous compounds. Among MSW, paper and paper board accumulation is around 20%.

The recycled paper market in the world runs back to 30 years. Certain countries show promising recycling rates for paper and paper board waste as illustrated in Table 1. In the U.S., 46 million tons (68.2%) of paper and paper board are subjected to recycling compared to other components in MSW. Among the European Union countries in 2017, Austria, Belgium, Germany, and Finland reached 83.5%, 92.9%, 87.1%, and 100% of recycling of paper and cardboard (Tiseo, 2022). When it

comes to Asia, China had reached 46.5% (54.93 Mmt) in 2020 (Statista Research Department).

Recycled papers can be made of a mixture of post-consumer papers, rejected papers from paper mills, pre consumer papers such as trims, and overs from printers that may contain virgin fibers. At present, 90% of the paper pulp is made of wood. Paper production is responsible for about 35% of clear-felled trees which is 1.2% of the earth's total commercial output (Kapse et al., 2018). One ton of newspaper recycling will save one ton of wood, while printing or copying paper recycling will result in saving more than 2 tons of wood (Soni et al., 2020). Also, virgin paper can be recycled up to 5 to 7 times (Soni et al., 2020). According to the EPA 2018 estimates, recycled paper production consumes 50% less water and reduces air pollution by 74% compared to virgin paper production. Therefore, it is very important to manage waste papers to conserve the environment to minimize obliteration and pollution due to the paper industry (Scott, 2019). However, poor fiber quality of recycled papers may result in problematic situations in different end uses of papers including printing, writing, and packing. Therefore, it is very important to evaluate the paper quality parameters of recycled papers to guarantee the satisfaction of different end users.

Most importantly, the permanence and durability of recycled papers should be measured to understand paper quality (Scott, 2019).

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