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Characterizing engineering properties of hermetic storage bag technology for standard development

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ABSTRACT

Post-harvest handling operations, including storage, plays a vital role in keeping a commodity safe from deterioration. One of the growing innovative technologies which aim to improve food safety and security of smallholder farmers is hermetic storage. Hermetic storage can effectively control insect activity in stored grains, oilseeds and pulses without using pesticides; thus, preserving product quality. One type of this storage technology uses gas impermeable film as a liner inside a woven polypropylene (PP), or jute sack called hermetic bags. With the increasing adoption of these bags, various brands are becoming available in the market. Manufacturers and distributors make claims about the performance of their brand and their efficacy in controlling biological activity. This study aimed to identify fundamental engineering properties as a basis for establishing an international engineering standard for testing and rating hermeticity of plastic-lined bags for smallholder farmers. Six commercially available hermetic storage bag liners (AgroZbag, Elite, PICS bag, SuperGrainbag, Storezo, Zerofly bag) were tested for tensile, dart impact energy, tear force, and permeability (oxygen transmission rate and water-vapor transmission rate) following ASTM test methods. Results indicated substantial differences ($P < 0.05$) in material properties among types of storage bag liners. This provided a basis for evaluating how these properties were affected by usage and handling practices. The maximum allowable oxygen and water vapor transmission rates were recommended to ensure hermetic conditions can be achieved. Limits for tensile properties, tear strength, and failure strength of hermetic bag liners were identified to ensure bag liners were sufficiently strong to hold a crop. Analyzing these properties will not only help in identifying "real" from "fake" hermetic storage bags but also having a standard approach to rate hermetic crop storage bags which will ensure the continued successful adoption of this critically important storage technology to control biological activity.

Keywords: Hermetic storage bag, Engineering properties, Oxygen transmission rate, Water-vapor transmission rate, Standards, Impact failure, Tear force, Tensile strength