RTB Working Paper

Measuring pressure during cassava dewatering with a lifting bag

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INTRODUCTION

To process cassava into flour, the roots are peeled, grated, dewatered, pulverized, dried, and milled. Dewatering is the process where moisture content of the material is reduced by mechanical means. It is an important step for energy saving, as removing moisture by mechanical means consumes substantially less energy than by drying with hot air. Dewatering also impacts the quality of the final dried product, particularly the uniformity on the moisture content, as inconsistency on moisture reduction during dewatering propagates through drying.

In small cassava processing enterprises dewatering is done with presses. The design and dimensions of those locally manufactured presses vary widely, but the large majority are hand-operated equipment using a lifting jack (Figure 1a) or a screw (Figure 1b) to exert the required force.

(a) (b)

Figure 1. Common types of presses used for mechanical dewatering of cassava, (a) jack operated press and (b) screw operated press.

To improve the consistency of the dewatering operation and consequently achieve the needed uniformity in the moisture content of the obtained pressed material, a dewatering protocol has been developed with a small cassava processing enterprise in Ghana, using a participatory approach. The aim was to define the steps and procedures needed to reliably achieve a moisture content of 40% on a wet basis. To accomplish this, the operators learnt that is important to always load the press with the same amount of material, exert always the same amount of force, and leave the material in the press always for the same amount of time. While controlling the amount of material and the amount of time proved to be easy, controlling the amount of force showed to be challenging, as those pressing equipment are devoid from any measuring instrument.

Lifting bags are devices used for raising loads in industrial applications. It consisted of a heavy-duty rubber bag, a pneumatic hose for inflation, and a manometer for pressure monitoring (Figure 2). In the lifting operation, the deflated bag is inserted under the object to be raised. Air is pumped to the bag via the hose, the bag inflates, and the object is lifted (Figure 3). The aim of this work was to investigate the use of a lifting bag as a device to measure pressure during cassava dewatering, as depicted in Figure 4.

Figure 2. Lifting bag, with a pneumatic hose to inflate it, and manometer to monitor pressure.

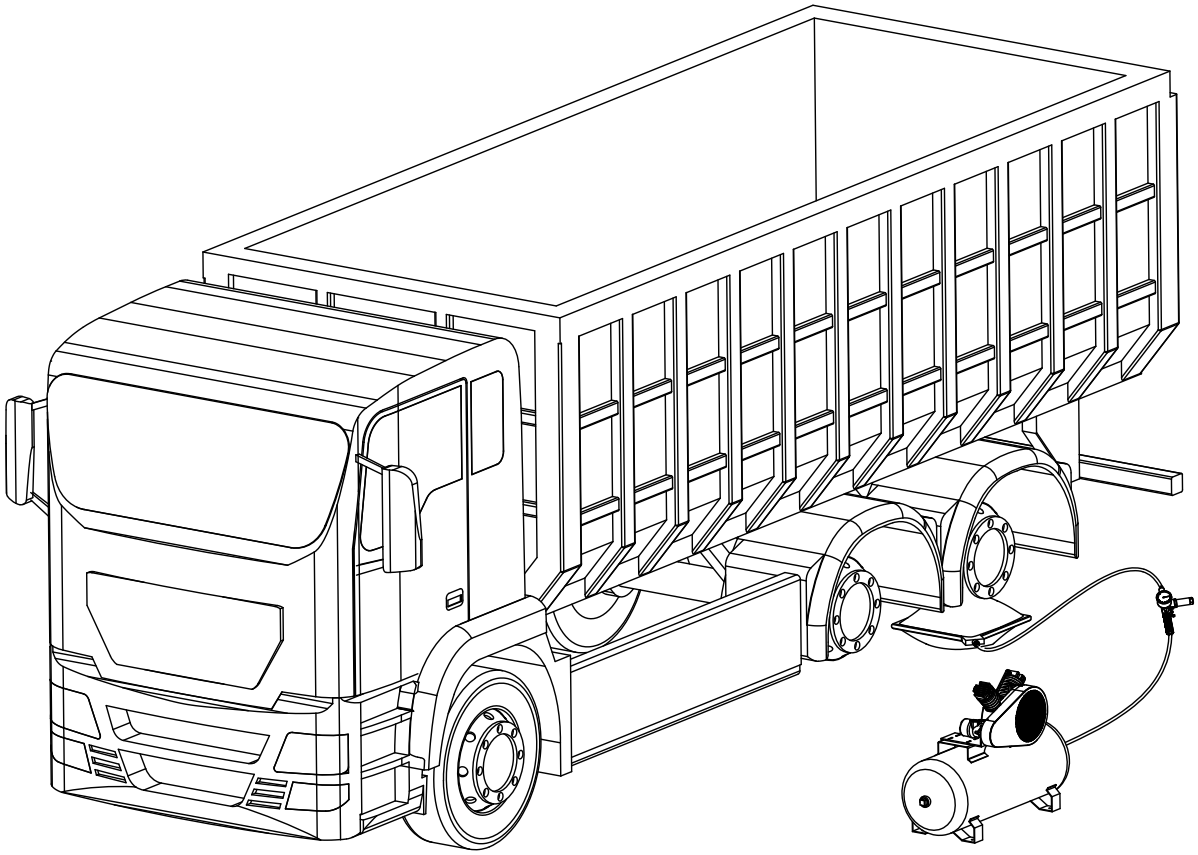

Figure 3. Lifting bags are commonly used in emergency and rescue operations to lift heavy objects.

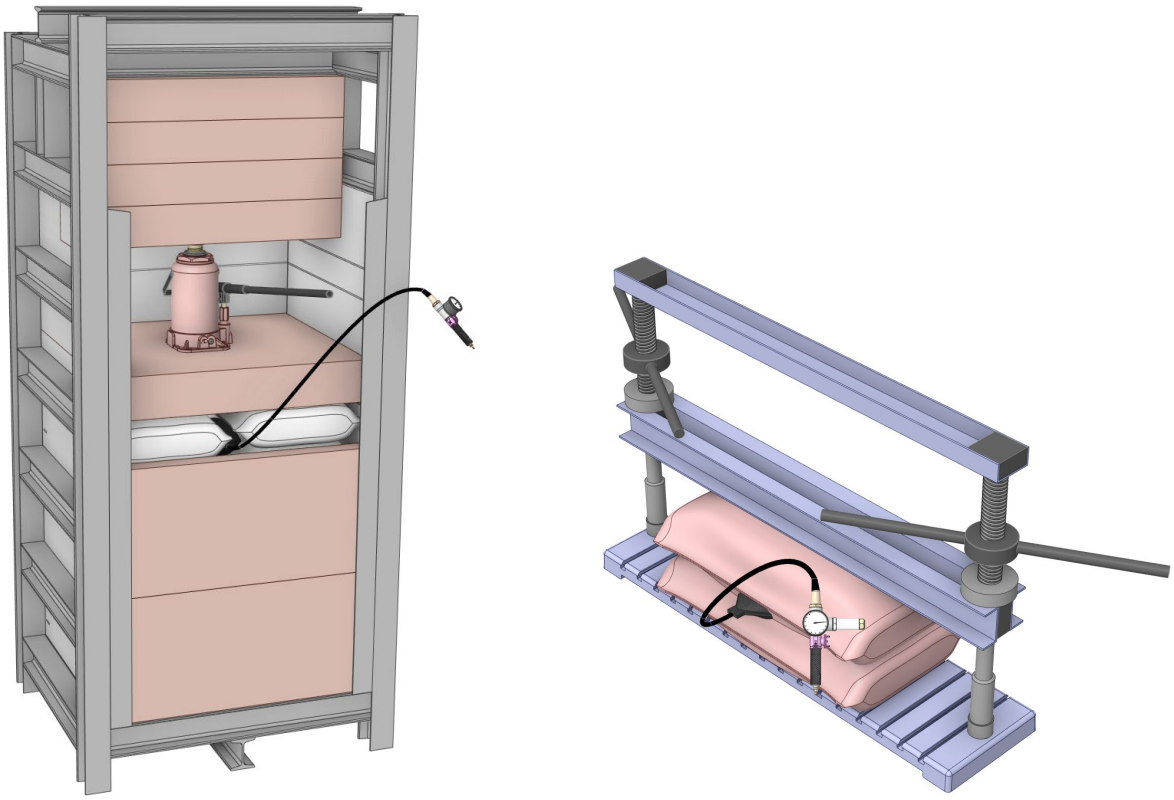

Figure 4. Concept of a lifting bag being used to measure pressure during cassava dewatering.

MATERIALS AND METHODS

A lifting bag (CLT1, Pronal, Leers, France) equipped with a pneumatic hose and a manometer, as well as a servo compression tester (Avery-Denison, DMG, Leeds, UK) were used in this study, as shown in Figure 5. Before being inserted to the compression tester, the bag was inflated with a hand-pump to 1 bar. The bag was squeezed by the tester and the pressure being applied by the equipment and the values displayed at the bag's manometer were recorded manually. A total of 144 measuring points were collected, ranging from 2.0 bars to 5.5 bars, with 3 repetitions.

Figure 5. Lifting bag evaluated with a servo compression tester, as an instrument to measure pressure.

RESULTS AND DISCUSSION

Figure 6 shows the correlation between the pressure applied by the servo compression tester and the values shown at the lifting bags manometer. A linear relationship was obtained, with the R^2 and slope, both close to one, and the intercept close to zero. According to Figure 6, the lifting bag can be used as a device to measure pressure with 95% of confidence.

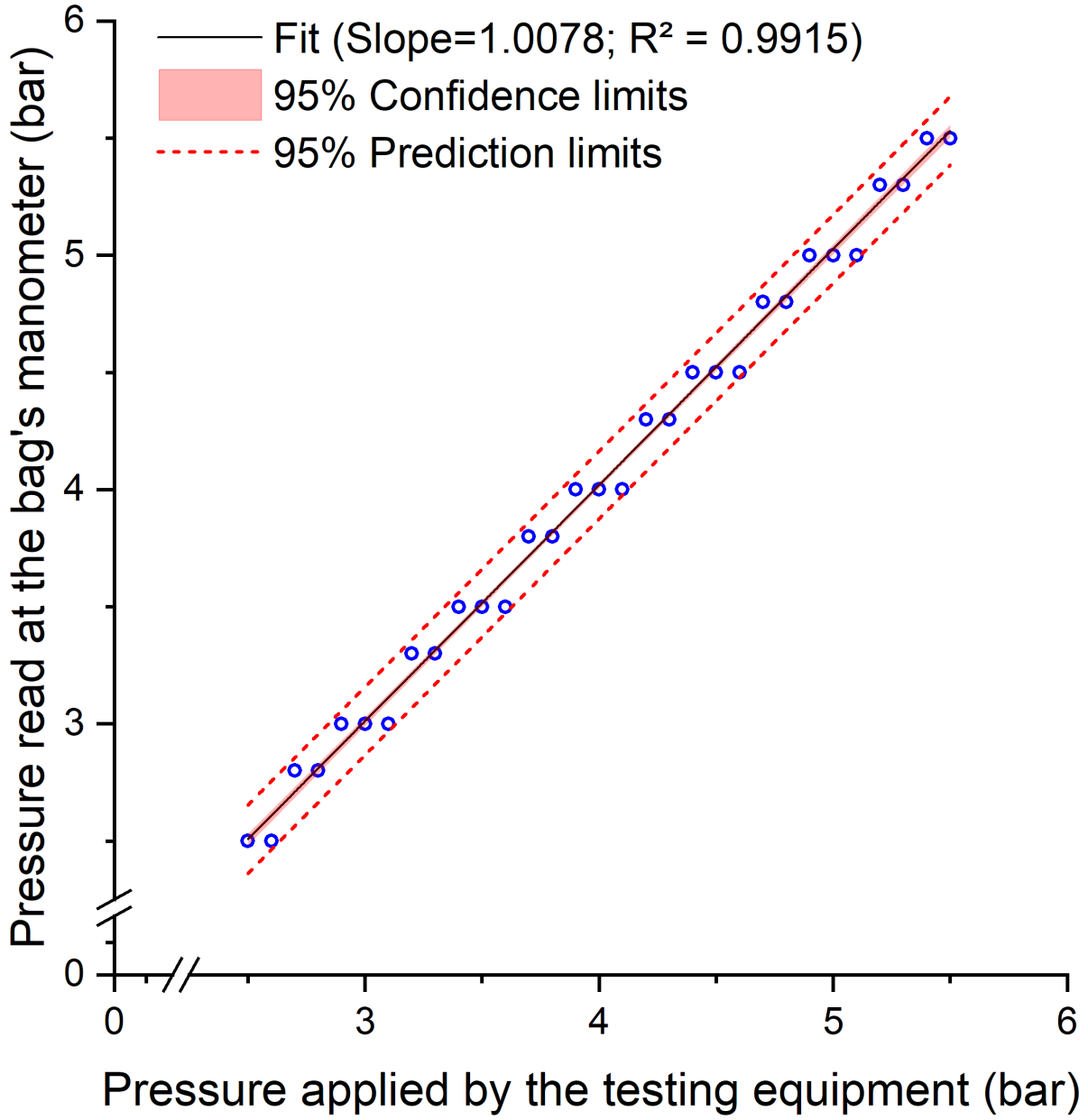

Figure 6. Correlation between pressure applied by the serve compression tester and the value shown at the lifting bag's manometer.

While the increase of the pressure applied by the servo compression tester was progressive, Figure 6 shows that the readings at the pressure bag manometer were in jumps, in a stepwise manner. This is explained by the manometer capacity to detect the smallest absolute amount of change. More accurate measurements could be obtained by using a manometer with higher sensitivity.

CONCLUSIONS

Lifting bags are devices used to raise heavy objects, but in this work, the use of lifting bags as a device to measure pressure during cassava dewatering was conceptualized and evaluated, using a compression tester. The study showed that the lifting bag manometer can accurately indicate the pressure being applied to the bag. The device has a much lower cost than any other force or pressure measuring instrument, and is commercially available, not requiring any modification to be used as sensor to measure pressure during cassava dewatering. It is expected that by monitoring the pressure being applied at the presses, the needed consistency of the dewatering operation will be achieved.

GUIDELINES ON BUYING LIFTING BAGS

In this study, a Pronal lifting bag was used, sold by Lifting Equipment Store (www.liftingequipmentstore.com). Any kind of lifting bag could be used, provided it can stand at least 8 bars of pressure. In general, the smaller the lifting bag the better, as it creates least disturbance to the capacity of the press. In this study the model CLT1 was used. It has a square shape, 150 mm by 150 mm and, when inflated, 90 mm of height. When acquiring a lift bag, lifting capacity and lifting height does not need to be considered. A compatible pneumatic hose and manometer should be acquired with the lifting bag, and most retailers sells it as a single package. Before using the lifting bag as a device to measure pressure, it is important to assure the absence of air leaks, as this would drastically affect measurements.

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