MECHATRONICS BOOK SERIES SYSTEM DESIGN AND SIGNAL PROCESSING

VOLUME 1

Editors
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CONTENTS

CHAPTER 31

Natural Ventilation of Yam Storage System

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31.1 Introduction

A typical atmospheric air consists of 78% nitrogen, 21% oxygen, 0.03% carbon dioxide and other composition of gases that make up the atmospheric air. The flow of air is therefore indispensible for the metabolic activity of yam tuber in order to guarantee its preservation. At the same time the yam tuber discharges water vapour and carbon dioxide. Therefore, if the composition of the atmosphere in the storage system deviates from the normal condition of the atmospheric air as a result of the metabolic activity, this can have a poor effect on the condition of the stored produce.

The excessive air moisture which can condense if the temperature of storage system falls, promotes the formation of rot and a very low concentration of oxygen prevents respiration and promote an undesired fermentation of the tubers in store. Therefore, the increased carbon dioxide and ethylene concentrations where yam tubers are stored are not desired. Increased carbon dioxide concentrations cause destruction of the tuber cell structure. Ethylene is a growth hormone which promotes germination [1].

Consequently it becomes clear that changes in the composition of the atmosphere in yam storage system are not desirable as these can have some negative effects on yam tubers. To alleviate these problems, the yam storage system must be sufficiently ventilated. Ventilation is not only for the purpose of gas exchanges between the store and the environment but it also affects the temperature in the yam storage system. Controlling ventilation is not simple as it can easily have counterproductive effects. Suppose the store is ventilated during the day, this can raised the temperatures and lead to undesirable heating of the stored produce. Inadequate ventilation at very low humidity promotes drying out of the tubers in storage. The store should consequently be ventilated at night as much as possible since temperatures are lower during this time and the relative humidity is normally higher than any other time [2]. Consequently, the air in storage system should have a humidity rate at which the exchange of water vapour is minimal. At a storage temperature of 26 - 28 °C which can be assumed typical for West Africa, a relative humidity of 70 - 80% leads to an equilibrium, in which the exchange of air between the tuber and its surroundings is very low [3]. With these storage conditions, the tuber retains the properties which define its quality like colour, aroma, flavour and chemical composition.

31.2 Theoretical Study of Natural Ventilation in a Yam Storage System

Natural ventilation in building has been studied theoretically and experimentally for a long time. The main driving force of air exchange in natural ventilation is the thermal buoyancy and the wind induced forces. In order to have a better understanding of the ventilation mechanism, these driving forces have been treated separately and two particular single span yam storage systems are investigated: the single sided longitudinal roof opening case and the case of a roof opening with a longitudinal side window opening.

In yam storage system, a few studies for predicting ventilation rate were available for roof ventilation or for both roof and side openings. From these studies one can conclude that the proposed calculations are restricted within narrow ranges for particular houses with special vent.