Design of the double pass solar collector for drying

Duy Tue Nguyen and Tri Nhut Do*

Van Lang University, 45 Nguyen Khac Nhu Street, Co Giang Ward, District No.#1, Ho Chi Minh City 700000, Vietnam

*trinhutdo@gmail.com or nhut.dt@vlu.edu.vn

Abstract. Solar energy is the free and nearly endless source which can be applied in various fields. Viet Nam locates near the equation and has enormous solar radiation, so this is the good chance for us to harness it. Moreover, Viet Nam is also the agricultural country with the large number of export product. With the large advantage in having enormous solar radiation, we can save up the large amount of energy for drying and other applications. In this paper, the 2 double pass solar collectors which have fins and without fins for drying were designed and simulated by CFD Ansys in some different conditions. The result displays that with the same size, the outlet temperature of the solar collectors with fins is 2 times higher than the without fins one. This temperature can reach 94.6°C with solar radiation 1026.32W/m2, mass flow rate 0.12kg/s and can reach 68.63°C with the same radiation and mass flow rate 0.18kg/s, so it is eligible for agricultural drying.

1. Introduction

The sun is a giant thermal ball that always reacts in the core, providing enormous heat. The sun's surface temperature of 6000°C corresponds to a radiation intensity of 70,000 to 80,000 kW per m^2, but the earth receives only a small fraction of this radiation intensity. If the total energy received from the sun to the earth of 174 petawatts (PW) per year could be completely exploited, that would meet more 10,000 times than the total energy used on earth in 1 year. The solar radiation intensity outside the atmosphere reaches to 1360 W/m^2. However, it is lost when penetrating the atmosphere, reduced to about 700 to 1000 W/m^2 depending on the region and season. Solar energy can be harvested for heating [1], lighting, cooking and a wide range of applications in life.

The direct drying process applied for drying agricultural products has the advantage of simplicity, low-cost. However, it is influenced by factors such as dust, insects and rain. Therefore, the chamber is used for drying in order to help minimize these effects. Moreover, the solar energy can be used during day time and resistors can be used during times of lack of sunlight, rain storms or at night in order to save energy. When using a solar-based drying system in a closed chamber, the internal temperature will be higher due to the greenhouse effect [2]. In the solar-based drying system, air is passed through the absorber plate, heated and fed into the drying chamber. However, a backup heat source is required in order to avoid product deterioration due to the effects of the weather [3]. This system achieves high operating efficiency due to the important part named the heat absorbing plate and increasing the heat transfer area by using metal and wavy fin.

A solar-based drying system with V-profile collector for drying tea and chili was experimented by Fudholit in [4]. The system is tested with solar radiation conditions of 700 W/m^2, total heat transfer area of