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# Effects of utilizing nanofluid as working fluid in a lab-scale designed FPSC to improve thermal absorption and efficiency

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## Abstract

The significance of using renewable energy has led to huge amount of studies on increasing the efficiency of the systems using these energies. The flat plate solar collector (FPSC) is one of the most common types of these systems. In this experimental study, we have made a change within the structure of a lab-scale flat-plate solar collector, and have increased its efficiency for public use. To this aim, a nanofluid containing $TiO_2$ particles was used as working fluid which does not circulate inside the FPSC. Purified water as the agent fluid was circulating inside the piping system and water storage tank. As a direct result, this mechanism increases the FPSC lifetime and reduces the costs compared to that of old versions. Moreover, a layer of *N*-$TiO_2$ particles was applied on the outer side of the FPSC collector glass surface. This technique improves the self-cleaning properties of the surface, and also enhances the collector thermal efficiency. Studied range for volume fraction of $TiO_2$ particles was from 0.1 % to 5%. The optimum volume fractions of $TiO_2$ particles were utilized to study the collector performance. The measured average diameter of the $TiO_2$ particles was about 20 nm. The nanofluid was prepared using a two-step method and by adding a sodium dodecyl sulfate (SDS) as surfactant. Results indicated that, using the nanofluid as working fluid, the collector efficiency was increased by about 45% and 17% for the volume fractions of 5% and 2.5% of $TiO_2$ nanoparticles, respectively. Besides, an increase in the $TiO_2$ particles volume fraction led to increment in absorbed heat by FPSC. Additionally, effects of initial temperature of tank water i.e. 0˚C, 10˚C, 20˚C, and 30˚C on the thermal efficiency was studied. Increasing the initial temperature showed positive influence on the efficiency. Moreover, regardless of whether the thermal connection is disconnected or connected, the collector does not lose its efficiency.

## Keywords

Flat plate solar collector (FPSC); nanofluid; working and agent fluid; thermal efficiency; thermal absorption and retention.

## 1. Introduction

These days, most of the countries are looking for a variety of solutions to eliminate their air pollution. On the other hand, people still insist on utilizing resources such as fossil fuels,