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Enhanced Photothermal Conversion efficiency of Magnetic Fluids for sustainable and resilience solar energy utilization

Author: Vivek Kichambaare[1]

Co-author: Kinnari Parekh [1]

[1] *Dr. K. C. Patel Research and Development Centre (KRADLE)*

Magnetic fluid has a very promising potential in heat transfer devices due to their better thermomagnetic properties as compared to base liquids. Also, its responsiveness towards magnetic fields making it more attractive choices than a nanofluid. With increasing demand of energy production and management, magnetic fluids offer better performance as a thermal energy absorber and storage such as in solar collectors to convert solar radiation into thermal energy. Looking to this potential, the present study investigates the photothermal conversion efficiency of two different magnetic fluids with 1.2 % volume fractions, namely transformer oil-based temperature-sensitive magnetic fluid (TSMF) and conventional Fe3O4-based magnetic fluid, under various conditions. The highest temperature on the top surface by absorbing light using TSMF was 183.1 ℃ while the conventional magnetic fluid temperature was 164.5 ℃ under a 4.82 mT external magnetic field. Besides, the maximum thermal conductivity of TSMF and Fe3O4 fluid were 0.143 W/m·K and 0.134 W/m·K, respectively at volume fraction of 1.2 % at 4.82 mT field. The photothermal conversion efficiency of TSMF and Fe3O4 fluid is respectively found as 50.84 % and 48.56 % at 4.82 mT magnetic field. This shows that TSMF has 2.2 % higher efficiency than Fe3O4 fluid. Thus, the results indicate that TSMF have higher potential to absorb light and convert into heat compared to Fe3O4 fluid.

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