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Hot Water Assisted Dry Ice Engine

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Abstract

This paper presents a modified dry ice engine design in which the reaction chamber (sphere) is surrounded by hot water. The system offers a low-temperature alternative to steam engines and is ideal for educational demonstrations of thermodynamic and propulsion principles.

Introduction

Traditional steam engines use water heated above its boiling point to produce steam that drives turbines. This research explores an alternative approach that uses the sublimation of solid carbon dioxide (dry ice) to produce gas under pressure. The inclusion of a hot-water bath surrounding the reaction sphere increases heat transfer, accelerating sublimation and improving engine performance.

Theory

The Hot Water Assisted Dry Ice Engine works on the principle of sublimation. Dry ice sublimates from solid to gas. When placed inside a hollow metallic sphere, dry ice slowly converts to CO_2 gas. However, by placing this sphere inside a hot-water bath, heat transfer from the water accelerates sublimation.

The generated CO_2 gas escapes through two small nozzles placed opposite each other. This creates thrust to rotate sphere. The hot water ensures continuous sublimation, maintaining steady pressure and rotation speed until the dry ice is depleted.

This system demonstrates fundamental concepts of heat transfer, phase change, thermodynamics, and propulsion, making it an effective teaching model for physics and engineering.

Experimental Setup

Sphere diameter: 4 cm

Sphere weight: 27 g

Nozzle tube diameter: 2.4 mm

Nozzle opening diameter: 0.5 mm

Dry ice used: 20–30 g

(with small amount of water)

Outer container: Holds hot water surrounding the sphere

Rotation time: ~120 seconds with 20 g dry ice

Working Principle

Hot water transfers heat to the sphere.

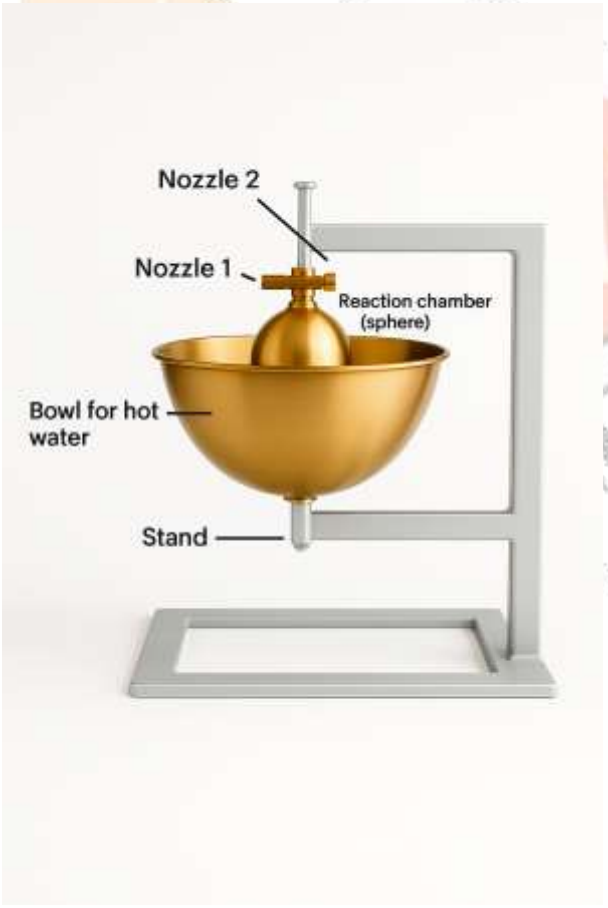
Dry ice sublimates faster, producing high-pressure CO_2 gas.

Gas escapes through nozzles, creating rotational thrust.

Motion continues until dry ice is exhausted.

Conclusion

The engine is a simple yet effective demonstration of energy conversion. By adding a water bath, performance is significantly improved compared to a standard dry ice engine. It serves as an excellent educational tool for demonstrating thermodynamics and propulsion without high-temperature hazards.



Future Scope

Use of insulated water bath for longer operation.

Optimized nozzle design for higher efficiency.

Scaling the system for higher power output in experimental research.

References

[1] Jones, W.M. "Sublimation of Carbon Dioxide: Kinetics and Heat Transfer Considerations." Journal of Thermophysics and Heat Transfer, vol. 14, no. 2, 2000, pp. 186-193.