IAF MICROGRAVITY SCIENCES AND PROCESSES SYMPOSIUM (A2)
Fluid and Materials Sciences (2)

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CFD OF SPACE STATION THERMAL COMFORT AND AIRFLOW BEHAVIOR UNDER MICROGRAVITY CONDITIONS

Abstract

In a space station, to ensure the thermal comfort of users, to get rid of infectious contaminants and to find a solution to the dissipation of body heat, it is necessary to maintain a homogeneous distribution of the air flow under microgravity conditions in a closed environment. In this work computational fluid dynamic (CFD) methods were applied to study the distribution of airflow and thermal comfort inside a space station. The simulation results and the pertinent literature data had a good level of agreement. Several conclusions are summarized. 1) The numerical results revealed that the air supply angle has the most significant impact on cabin air circulation. A slight increase in the angle resulted in an expanded speed range throughout the cabin. 2) In the absence of gravity-induced convection, air tends to homogenize through diffusion, resulting in a more even distribution of air in microgravity environments over time. In microgravity, there is no significant buoyancy-driven flow, and air behaves differently. 3) When the air supply angle is set at 25 degrees, it yields unfavorable outcomes, resulting in the lowest ventilation efficiency. Additionally, most calculated values for Effective Draft Temperature (EDT) fall outside the range of (-1.7 to 1.1 K). In this scenario, 804) At the 25-degree angle, most of the air within the cabin interior exhibits lower velocities, with less than 415) when the air supply angle is set to 45 degrees, it demonstrates the highest ventilation efficiency. The majority of the computed Effective Draft Temperature (EDT) values fall within the range of (-1.7 to 1.1). 6) Enhancing thermal comfort and air quality can be achieved by optimizing air distribution through adjustments in the air supply angle. When the air supply angle was set to 45 degrees, a significant 78