

EFFECTS OF HEAT FLUX, OXYGEN CONCENTRATION AND GLASS FIBER VOLUME FRACTION ON PYROLYSATE MASS FLUX FROM COMPOSITE SOLIDS

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Experimental work on the effects of heat flux, oxygen concentration and glass fiber volume fraction on pyrolysis mass flux from samples of polypropylene/glass fiber composite (PP/G) is underway. The research is conducted as part of a larger project to develop a test methodology for flammability of materials, particularly composites, in the microgravity and variable oxygen concentration environment of spacecraft and space structures. Samples of PP/G sized at 30x30x10 mm are flush mounted in a flow tunnel, which provides a flow of oxidizer over the surface of the samples at a fixed value of 1 m/s and oxygen concentrations varying between 18 and 30%. Each sample is exposed to a constant external radiant heat flux at a given value, which varies between tests from 10 to 24 kW/m². Continuous sample mass loss and surface temperature measurements are recorded for each test. Some tests are conducted with an igniter and some are not. In the former case, the research goal is to quantify the critical mass flux at ignition for the various environmental and material conditions described above. The later case generates a wider range of mass flux rates than those seen prior to ignition, providing an opportunity to examine the protective effects of blowing on oxidative pyrolysis and heating of the surface.

Graphs of surface temperature and sample mass loss vs. time for samples of 30% PPG at oxygen concentrations of 18 and 21% are presented in the figures below. These figures give a clear indication of the lower pyrolysis rate and extended time to ignition that accompany a lower oxygen concentration. Analysis of the mass flux rate at the time of ignition gives good repeatability but requires further work to provide a clear indication of mass flux trends accompanying changes in environmental and material properties.

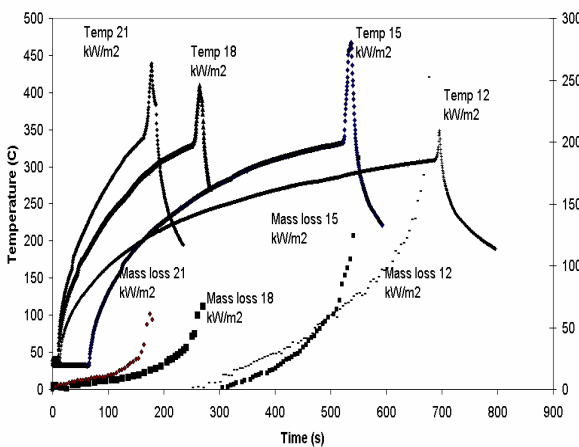


Fig. 1. Comparison of surface temperatures and mass loss values of PP/G 30% at 21% O₂ concentration for varying heat fluxes.

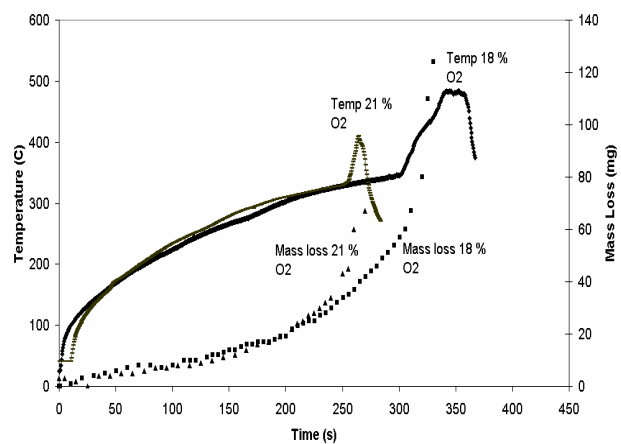


Fig. 2. Comparison of surface temperatures and mass loss values of PP/G 30% at 18 kW/m² for varying oxygen concentrations.