A novel surrogate lung material for impact studies: Development and testing procedures

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A novel surrogate lung material for impact studies: Development and testing procedures.

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Abstract This work focuses on the development of a surrogate lung material (SLM) that reproduces the dynamic response of a human lung under various loading conditions and also allows for the analysis of the extent and distribution of damage. The SLM consists of polyurethane foam used to mimic the spongy lung tissue and fluid-filled gelatine microcapsules used to simulate the damage of alveoli.

The bursting pressure of the microcapsules was investigated by conducting low and high rate compression tests on a single microcapsule. A bursting pressure of around 5 bar was measured which is comparable to the reported lung overpressure at injury level.

Low and high rate compression tests were conducted on the SLMs. From the measured mechanical properties and mass density, the stress wave speed was calculated and found to be well in the range of the reported values for human lungs (16-70 m/s).

In order to study the extent and distribution of damage in the SLMs, as represented by burst microcapsules, a CT scan analysis was carried out before and after the impacts. The CT scan results clearly demonstrated the magnitude and distribution of damage within the specimen. The results are then compared to the Bowen curves, the most often used criteria for predicting blast injuries in humans. An excellent agreement was found between the observed damage in the surrogate lungs and the expected damage in real human lungs.