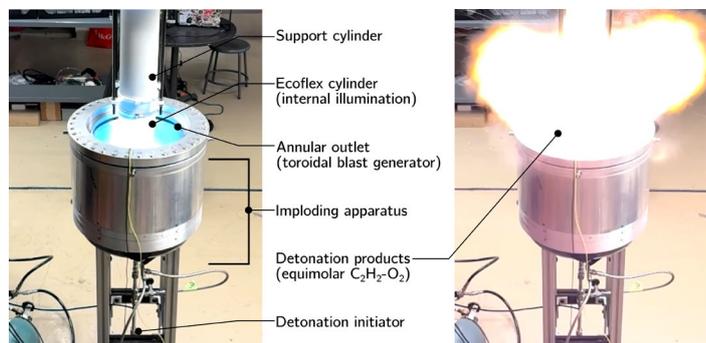


Gas-Phase Detonation as a Driver for Imploding Elastomer and Liquid Cylinders

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Abstract

The implosion of cylindrical and spherical geometries arises in numerous applications, most notably in inertial confinement and magnetized target strategies for fusion energy. Traditional methods for driving such implosions include using pulsed lasers, pulsed power systems, or high explosives as drivers—each of which typically destroys both the test specimen and its supporting hardware. However, for softer materials such as elastomers and liquids, gas-phase detonation offers an innovative alternative for driving implosions in a benchtop laboratory setting, with the advantages of rapid cycling and reusability. The present project utilizes an updated version of the imploding detonation apparatus developed by Rodriguez Rosero et al. [1] to generate symmetrically inward-directed detonations that produce a toroidal blast wave propagating into an open cavity. This toroidal blast is used to implode open cylinders, 10 cm in diameter, composed of either silicone elastomer (e.g., Ecoflex™ 00-30) or liquids (e.g., water, silicone oils, etc.), achieving wall velocities of up to 100 m/s. The implosion dynamics are captured by imaging the cylinder's interior through high-speed videography and photonic Doppler velocimetry (PDV). This poster presentation will highlight the detonation-specific features of the apparatus—namely, the requirement to initiate and sustain a highly symmetric detonation capable of generating a well-characterized toroidal blast wave and the challenge of minimizing excessive illumination from detonation byproducts that engulf the test sample. Preliminary visualizations of instabilities (e.g., pulse buckling, Rayleigh-Taylor, etc.) on the inner surface of the cylinders will also be presented.



- [1] Rodriguez Rosero S, Loiseau J, Higgins AJ. (2024) Asymmetry of imploding detonations in thin channels. *Shock Waves*. 34(5):413-27.