CAVITATION EROSION TESTING (ASTM G32-92)

SONICS & MATERIALS, INC.

Because evaluation of cavitation erosion resistance can be facilitated using ultrasonics and the simulation test mandated in ASTM G-32, Sonics & Materials 20 kHz, variable amplitude, 500 watt ultrasonic processors Model VC505 or VCX 500 have become the instruments of choice for implementing either the direct or the indirect cavitation tests.

DIRECT CAVITATION

The longitudinal ultrasonic vibrations generated by the piezoelectric crystals within the converter are amplified by the probe (horn) and transmitted into the liquid as ultrasonic waves consisting of alternate expansions and compressions. The pressure fluctuations pull the liquid molecules apart creating micro-bubbles (cavities), which expand during the negative pressure excursions, and implode violently during the positive excursions. As the bubbles collapse, millions of shock waves, eddies and extremes in pressures and temperatures are generated at the implosion site causing microjets to impinge on the surface of the test specimen, causing erosion (material loss). This test method may be used to estimate the relative resistance of materials to cavitation erosion as may be encountered, for instance, in pumps, hydraulic turbines, valves, bearings, ship propellers etc...

A specimen tip of proper mass is weighed accurately before testing. The tip is threaded onto the probe (horn) and immersed into a container of the test liquid (generally distilled water) that is maintained at a specified temperature -typically 25+/- 2 degree C, and ambient pressure. The probe is vibrated at 20 kHz at a specific amplitude, usually 50um, for a predetermined duration.
The weight of the specimen is noted, after it has been thoroughly dried, then returned to the bath for additional processing and again weighed. This test/interruption cycle is repeated in order to obtain a history of mass loss versus time (which is not linear). Most specimen display an "incubation period" during which time very little weight loss is observed. The longer the incubation time, before major weight loss occurs, the better is considered to be the material's cavitation erosion resistance. Appropriate interpretation of this cumulative erosion-versus-time curve permits comparison of results between different materials or between different test fluids or other conditions.

INDIRECT CAVITATION

An alternative test for cavitation erosion, using the same equipment, is the indirect cavitation method or stationary specimen method. In that method, the specimen is fixed within the liquid container, and the vibrating tip of the probe is placed in close proximity to it. The cavitation generated by the probe acts on the specimen. This method is commonly used when working with brittle specimens which cannot be threaded.

NOTE: Ultrasonic probes with replaceable tips are very much like tuning forks and are designed to vibrate at a specific frequency – 20 kHz. If the probe with the replaceable tip does not vibrate at that frequency, the ultrasonic power supply will go into an overload condition and stop working, or breakdown. Because machining of the tip is critical, to ensure proper and reliable operation, it is recommended that a piece of the specimen material be submitted to Sonics & Materials for fabrication.

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