



CALIFORNIA STATE SCIENCE FAIR 2014 PROJECT SUMMARY

Name(s) Michael Kao	Project Number 34914
Project Title The Strength of Alloys: Testing Industrial Alloy Strength against Cavitation Erosion	
Objectives/Goals The objective of this experiment will be to investigate the behavior of cavitation and cavitation erosion conducted towards industrial alloys. The experiment will be evaluating metals that resist cavitation, factors that affect cavitation resistance, and the behavior of cavitation with proportion to the experiment time. Abstract Methods/Materials A Branson 450 Sonifier was used to generate an ultrasonic field producing oscillating voids in a 1000mL water container to cause cavitation. Test specimens will include 4 mm, 6mm, and 8mm tablets of Aluminum 6061 T6, Nickely Alloy 200, UM Brass A353, Stainless Steel 316, Grade 2 Titanium, and GP Low Carbon Steel. Metals machined into tablets with sizing appropriated to the Sonifier horn tip size, and thread sizing will follow standard UNC sizes. Metals will be placed within the container of water at intervals of 10 minutes, where material loss will be subsequently recorded. Test duration for each specimen continues until cavitation reaches a horizontal asymptote. Results Consistent erosion rate charts prove cavitation is not a linear process, but a phenomena whose erosion rate depends on the experiment time itself. Erosion amounts followed an exponential trend and then subside into a logarithmic trend. Testing results showed that stronger materials such as nickel (ex. average 144 mg loss, 120 min.) lasted longer than materials such as aluminum (ex. average 58 mg loss, 120 min). Note that due to machine failure from over-usage, not all 18 tablets could be properly tested. Conclusions/Discussion Analysis of cavitation behavior and research shows that cavitation acts in an incubation, accumulation, attenuation, and steady state process order. Using alloy properties, cavitation resistance is the reciprocal of material loss rate but does not correlate to any other property of metals such as elongation or tensile strength. Resistance depends on a variety of factors of the metal, not just single characteristics that determine metallic strength. Machines such as valve systems, hydraulic pumps, and hydrofoils require proper materials to effectively avoid substantial cavitation damage. Information provided by this experiment is useful for industrial manufacturers to determine preferable alloys for use in pressurized fluid machines and hydrodynamic devices.	
Summary Statement Industrial alloys will be subject to ultrasonic non-inertial cavitation to determine factors affecting cavitation resistance and behavior of cavitation with proportion to time.	
Help Received Acknowledgements to father for assistance in machining tablets and minor troubleshooting; mother assisted in acquiring materials.	