Contribution ID: **89** Type: **Oral**

PRELIMINARY EXPERIMENT ON SHOCK WAVES GENERATED BY UNDERWATER ELECTRICAL EXPLOSION OF WIRES

Wednesday, 21 June 2017 10:30 (15 minutes)

It is well-known that underwater electrical wire explosion (UEWE) is accompanied by generation of strong shock waves (SSW) with fast front and short duration, which makes it attractive for various scientific and technological purposes. In this paper, a device for UEWE was developed and composed of pulse capacitors (200μF, 1˜6kV), a spark gap switch, and a metal wire immersed in a chamber filled with water. The total inductance of circuit is 1.2μH and resistance is 14mΩ, while the pulsed current is 1.4kA/μs in rise rate and 2kA to 50kA in amplitude depending on the charging voltage of the capacitors and wires used. A Rogowski coil and a voltage divider were used for the measurements of the current and the voltage on the wire load, respectively. The shock waves were recorded by a piezoelectric pressure probe (model: PCB138A11). The amplitude of the shock waves was measured to be 82.4MPa at 50mm from the exploding wire. The effects of the experimental parameters (including the wire diameter, the storage energy in capacitors, the energy deposition into the wire) on the shock waves were investigated. The transfer rate from the storage energy to the deposition energy was calculated for different conditions. It was shown that the thicker copper wires would generate the stronger shock waves and the amplitude of shock wave was approximately proportional to the energy deposition into the wire. For the potential application in the oil exploitation, the destruction of the concrete cylinders with a thickness of 75mm by the shock wave was studied. The storage energy of 0.9 kJ is high enough to break the concrete cylinder into pieces. At a position of 75mm from the exploding wire, the shock wave measured in the concrete cylinder attenuates to 43.5% in amplitude of that measured in water without the cylinder.

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Session Classification: Oral session 13 - High-Voltage Insulation and Dielectric Breakdown Phenomena, Explosively-Driven Pulsed Power - Session Chair : Yakov Krasik

Track Classification: Pulsed Power Physics and Technology, Components and HV Insulation