PlasTEP

plasma for environment protection

Report on tests of prototype plasma device for water cleaning at simulated conditions

OP6-6.1

PP #12 (IMPPAN, Gdańsk, Poland)

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1. Introduction

The aim of the WP6 of the PlasTEP project is developing a prototype of mobile device for destruction of oil and oil-type leakages in ports of the Baltic Sea. Following the WP6 schedule Partners from Greifswald in Germany (INP, PP#2), Mikkeli in Finland (LUT, PP#6), Gdańsk in Poland (IMP, PP#12) and Szczecin in Poland (ZUT, PP#13) are obliged to perform joint tests of their modules combined and matched after optimisation. Modules in a final form together with a floating platform form the desired mobile device. In November 19th, 2012, in Szczecin, tests of the performance of the final device were carried out. Results of these tests are presented briefly in this report.

2. Conditions

Tests were carried out outdoor using small diagnostic pool administrated by the Faculty of Maritime Technology and Transport of the Westpomeranian University of Technology in Szczecin, Poland. Air humidity was about 90% RH and temperature was 5^{o}C. Since the sky was cloudy, batteries being the power source for the device were charged earlier from the grid, not using the solar panel.

3. Testing procedure

The device was delivered to the pool by a track equipped with a crane (Fig. 1). After placing on the water the device was checked for the depth of draught. Since it was too high, i.e. oil-water separator was completely below the water level, the device was pulled up. The construction of the device allows for changing the vertical position of floats against the platform, so after fixing new positions the device was placed on the water again successfully.

Fig. 1. Moving the mobile plasma device to the testing pool.

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Next step was starting the operation of the device. The cover with solar panel was opened in order obtain access to the flask with argon and to observe visually behaviour of all device components (Fig. 2).

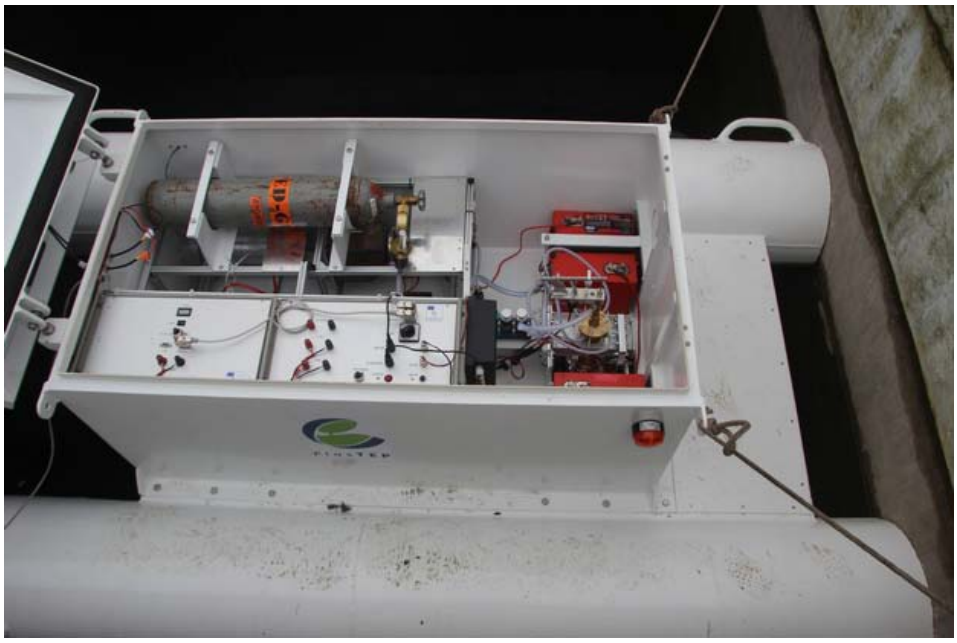

Fig. 2. Interior of the mobile device after placing in the pool.

Control of the device was carried out with a computer, so all the time the device was connected with the PC by a wire. The first step of running the device was ignition of microwave plasma with an automatic igniter (Fig. 3).

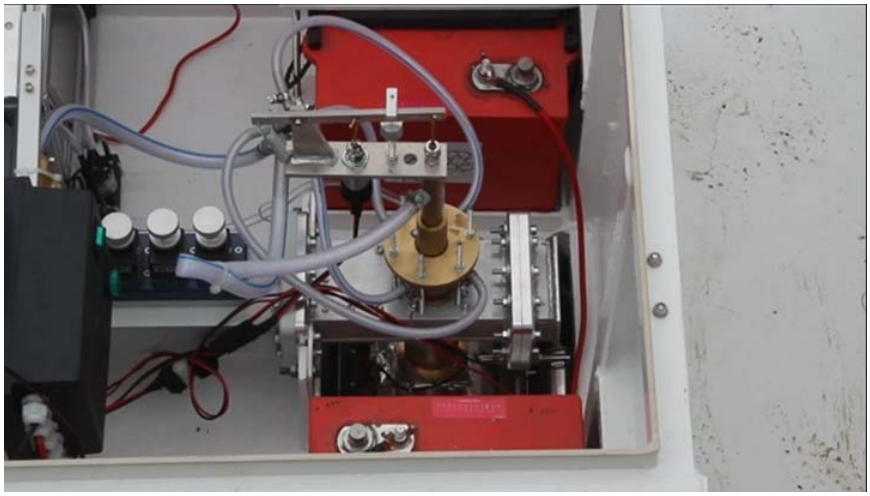

Fig. 3. Igniter on the microwave plasma module.

Unfortunately, for unknown reasons, the microwave plasma did not start for a long time. Only after some changes in the electronic system controlling power delivery to the plasma module the plasma started (Fig. 4).

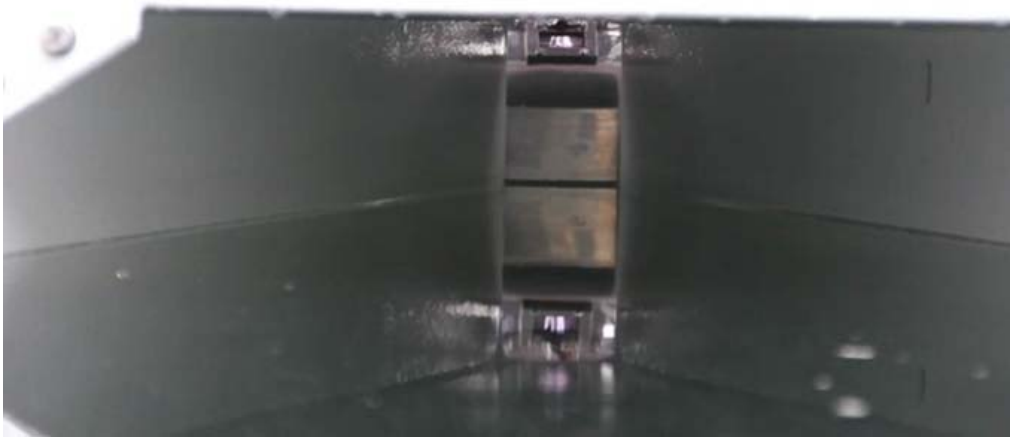

Fig. 4. Bottom of the device placed in the pool with microwave plasma running.

The next step was to start pumping the gas from the microwave plasma module to the dielectric barrier discharge (DBD) module and igniting DBD plasma (Fig. 5). This was done successfully and it was decided to check an oil slick destruction by the device. For that purpose 15 ml of kerosene as a simulator of oil was sloped onto the water surface (Fig. 6).

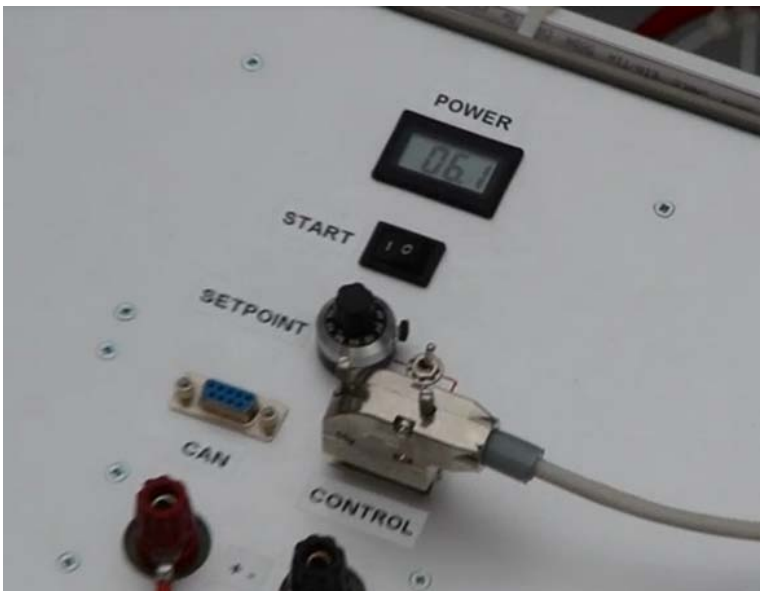

Fig. 5. Intermediate power consumption by the system supplying dielectric barrier discharge module.

Fig. 6. Sloping 15 ml of kerosene onto the water surface in front of the plasma device.

4. Results and conclusion

Processing of kerosene slick by the constructed plasma mobile device resulted in partial destruction of kerosene. As can be seen in Fig. 7 there are still rests of kerosene behind the device, i.e. after the plasma processing. The reason for that is to wide drum size causing that microwave plasma do not treat kerosene covering edges of the drum.

Fig. 7. Rests of kerosene after plasma processing.

As for the stability and time of the device operation the test give no answer because of malfunction in the power supply controlling system. Unfortunately, this problem was not solved immediately and forced the team to stop tests.

5. Conclusions

The aim of the test was the checking of the plasma mobile device performance in simulated conditions, i.e. in the field, on the water and with an kerosene as a simulator of oil slick.

The general result of tests is that device works and destroys partially the kerosene slick. However, it needs further optimization, in particular towards:

- more efficient kerosene separation in order to process by microwave plasma all kerosene separated from water,
- improvements in power supply controlling system to ensure reliability,
- equipping the device with a propulsion.