Comparative study of decomposition of tetrachloromethane using dielectric barrier discharge powered by different power supplies

Bogdan Ulejczyk[1], Krzysztof Krawczyk[1], Alicja Kosik[1], Michał Młotek[1], Krzysztof Schmidt-Szałowski[1], Łukasz Nogal[2], Bolesław Kuca[2]

[1] Faculty of Chemistry, Warsaw University of Technology, Noakowskiego 3, 00-664 Warszawa, Poland
[2]Faculty of Electrical Engineering, Warsaw University of Technology, Pl. Politechniki 1, 00-661 Warszawa, Poland

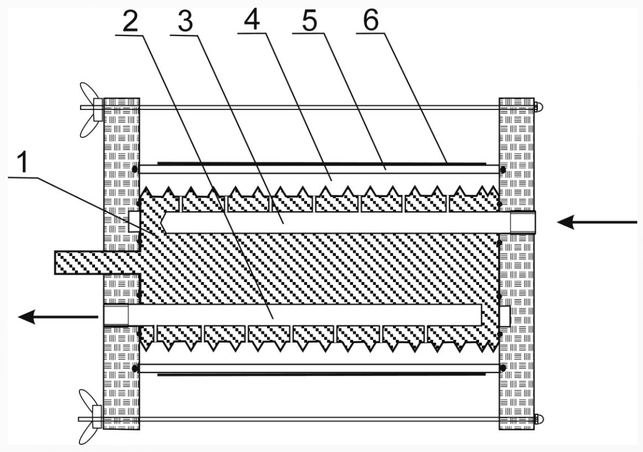
Volatile organic compounds cause the greenhouse effect. They often possess toxic properties. Moreover some of them cause the decomposition of ozone.
This study is focused on CCl_4 decomposition in a newly constructed dielectric barrier discharge reactor. The reactor has a special design of the high-voltage electrode. This electrode has internal channels. Gas is introduced into the whole reactor by one group of channels. The gas passes through the discharge zone. Then the gas is carried from the reactor by the next channels. This design aims to improve the energy efficiency supply of dielectric barrier discharge.
The reactor was powered by three power suply systems: AC, pulsed of low frequency (<1 kHz) and pulsed current of 15 kHz frequency.

Experimental conditions

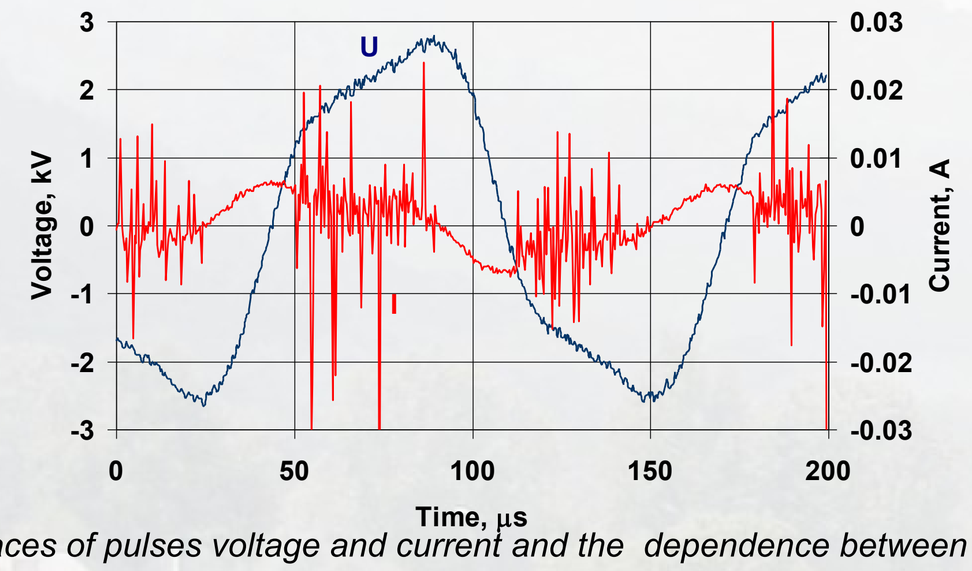
Gas mixture - air and CCl_4
Total gas flow - 10 Nl/h
CCl_4 concentration – 0.1%

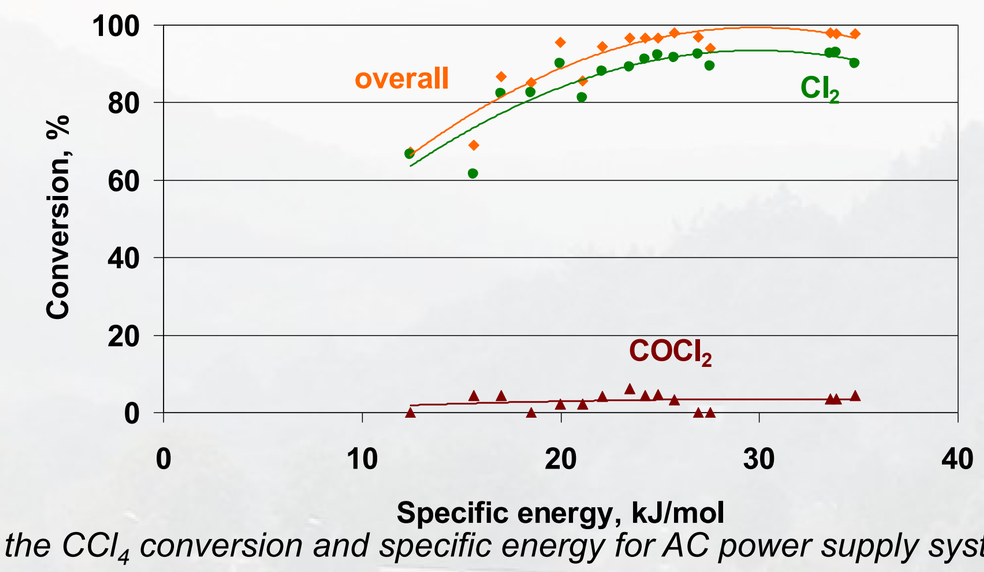
Reactor

1 – high-voltage electrode
2, 3 – internal channels
4 – discharge zone
5 – dielectric barrier
6 – grounded electrode

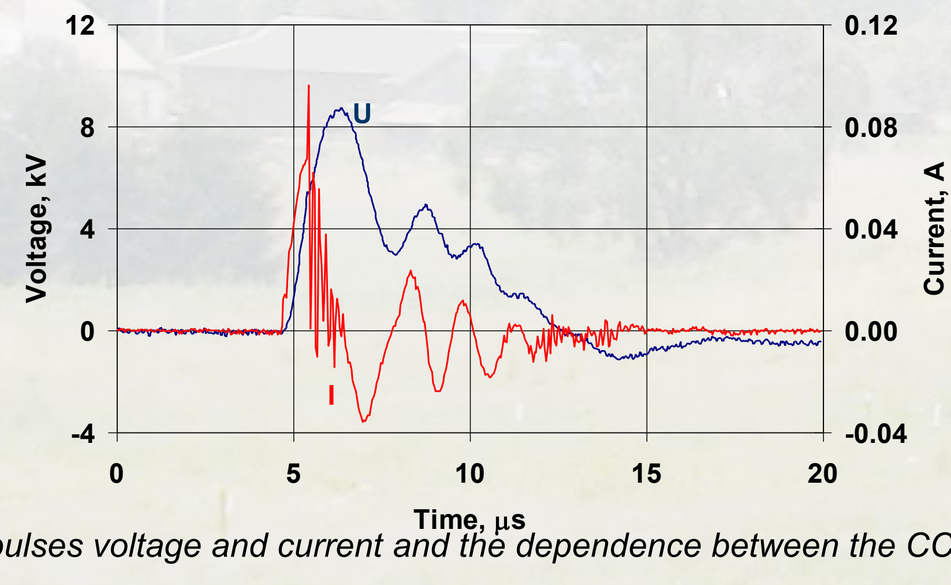


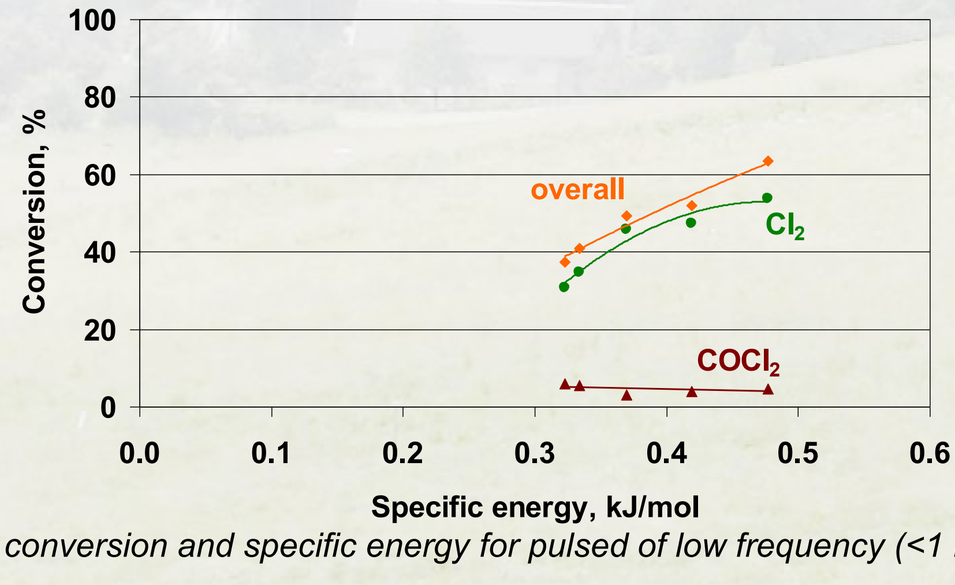
Results



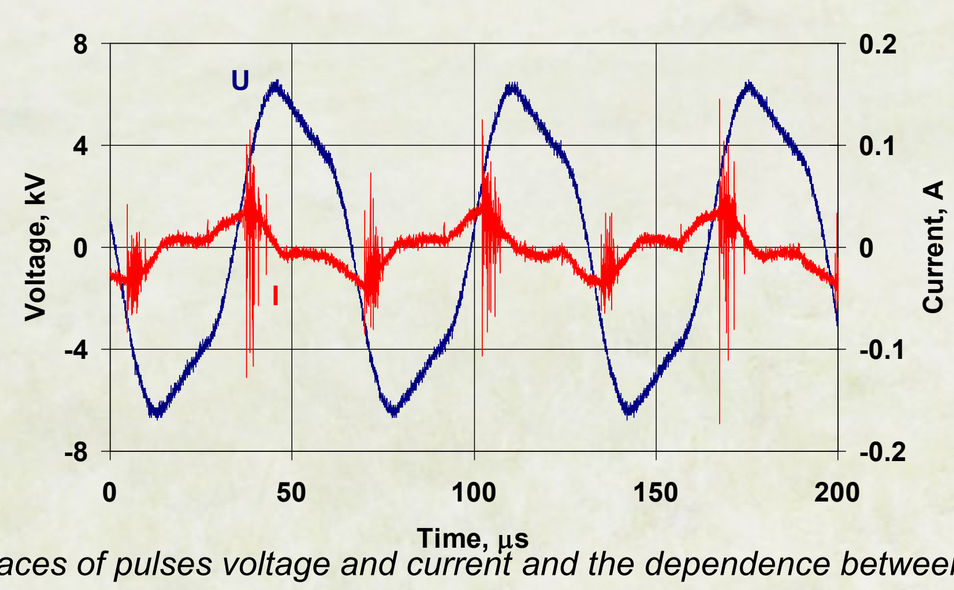


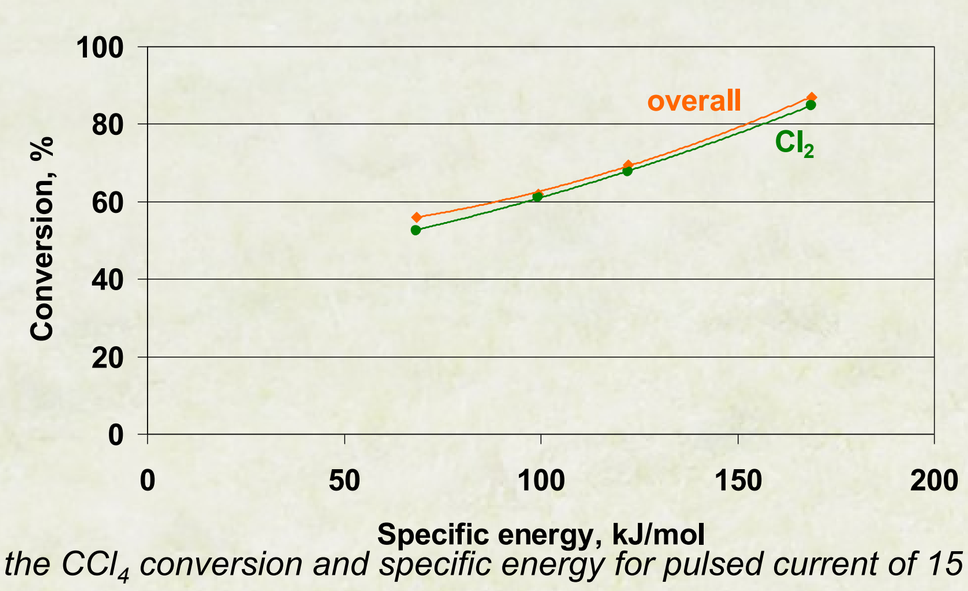
Traces of pulses voltage and current and the dependence between the CCl_4 conversion and specific energy for AC power supply system





Traces of pulses voltage and current and the dependence between the CCl_4 conversion and specific energy for pulsed of low frequency (<1 kHz) power supply system





Traces of pulses voltage and current and the dependence between the CCl_4 conversion and specific energy for pulsed current of 15 kHz frequency

Conclusions

- The reactor with the special high-voltage electrode can be effectively used for decompositon of CCl_4 in air.
- Effects of CCl_4 decomposition depends on the type of power supply system.
- The best overall CCl_4 conversion have been obtained for the AC power supply system (98%).
- Main product of CCl_4 decomposition was Cl_2.
- $COCl_2$ was not produced in the reactor powered by pulsed current of 15 kHz frequency power supply system.

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