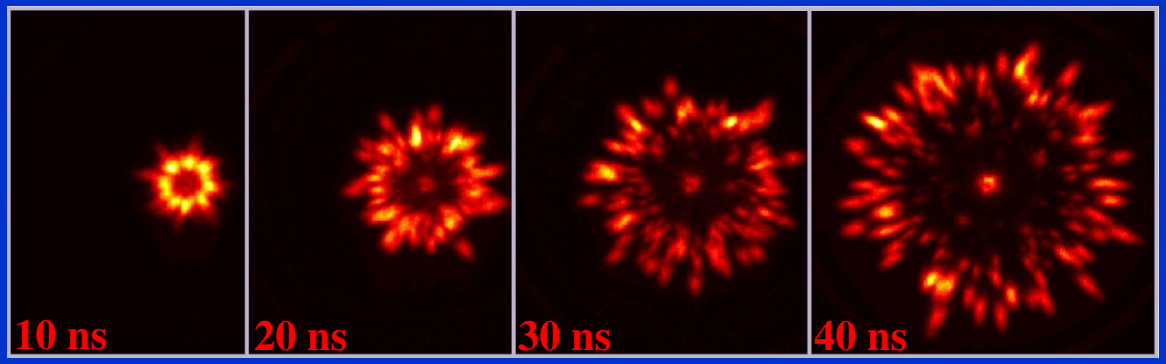
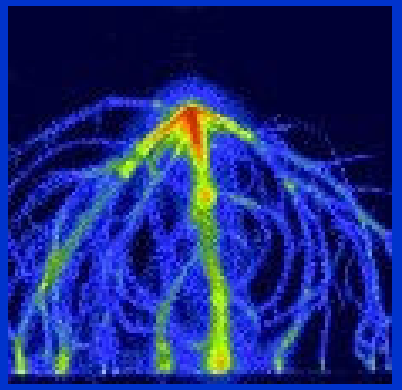
AN INDUSTRY SCALE CORONA-PLASMA FOR FLUE GAS DESO2/DENOx TECHNIQUE BY HIGH FREQUENCY AC+DC POWER SUPPLY WITH A SEMI-WET FLOW

Streamer plasma :



P.P. M. Blom, PhD Thesis, TU/e, 1997

Key-problem-----ns pulse source

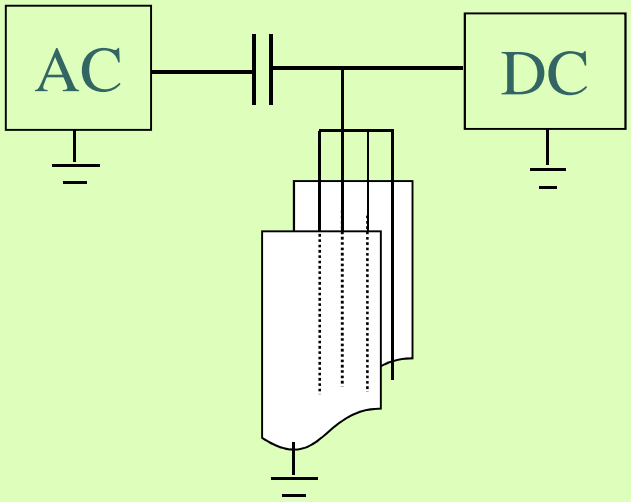


Dr. E.M. van veldhuizen, TU/e, 2000

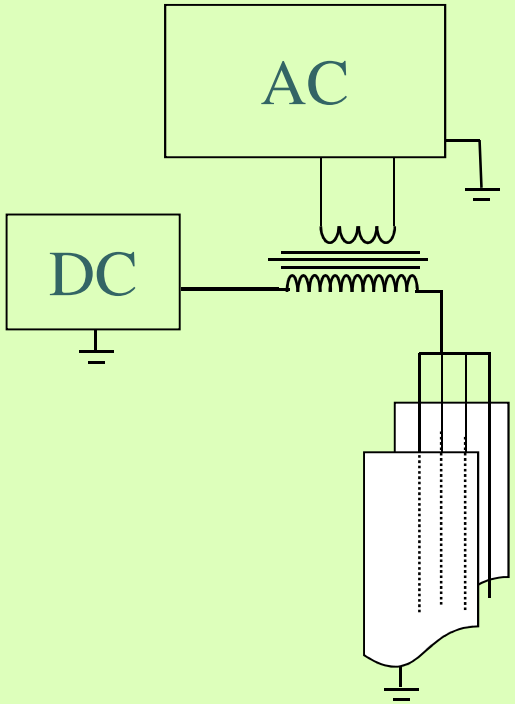
Industrial use research

group	power	Switch device	Pulse width	status
ENEL Italy	10 kW	Thyratron (300 pps)	≈ 1000 ns	Discontinued
FLS miljo Denmark	8 kW	rotary spark gap	≈2500 ns	discontinued
Masuda research Japan	10 kW	rotary spark gap	≈ 1000 ns	commercial
Toshiba Japan	50 kW	magnetic compression (1000 pps)	≈ 500 ns	commercial
Electro-Techn Inst Korea	120 kW	magnetic compression	≈ 200 ns	developments
Inha Univ. Korea	20 kW	thyratron and pulse transformer (1500 pps)	≈ 200 ns	developments
China engineering physics institute	100 kW	thyratron and magnetic compression (300 pps)	≈ 500 ns	demonstration

DC+AC couple mode



(a): C-COUPLE



(b): Transformer-couple

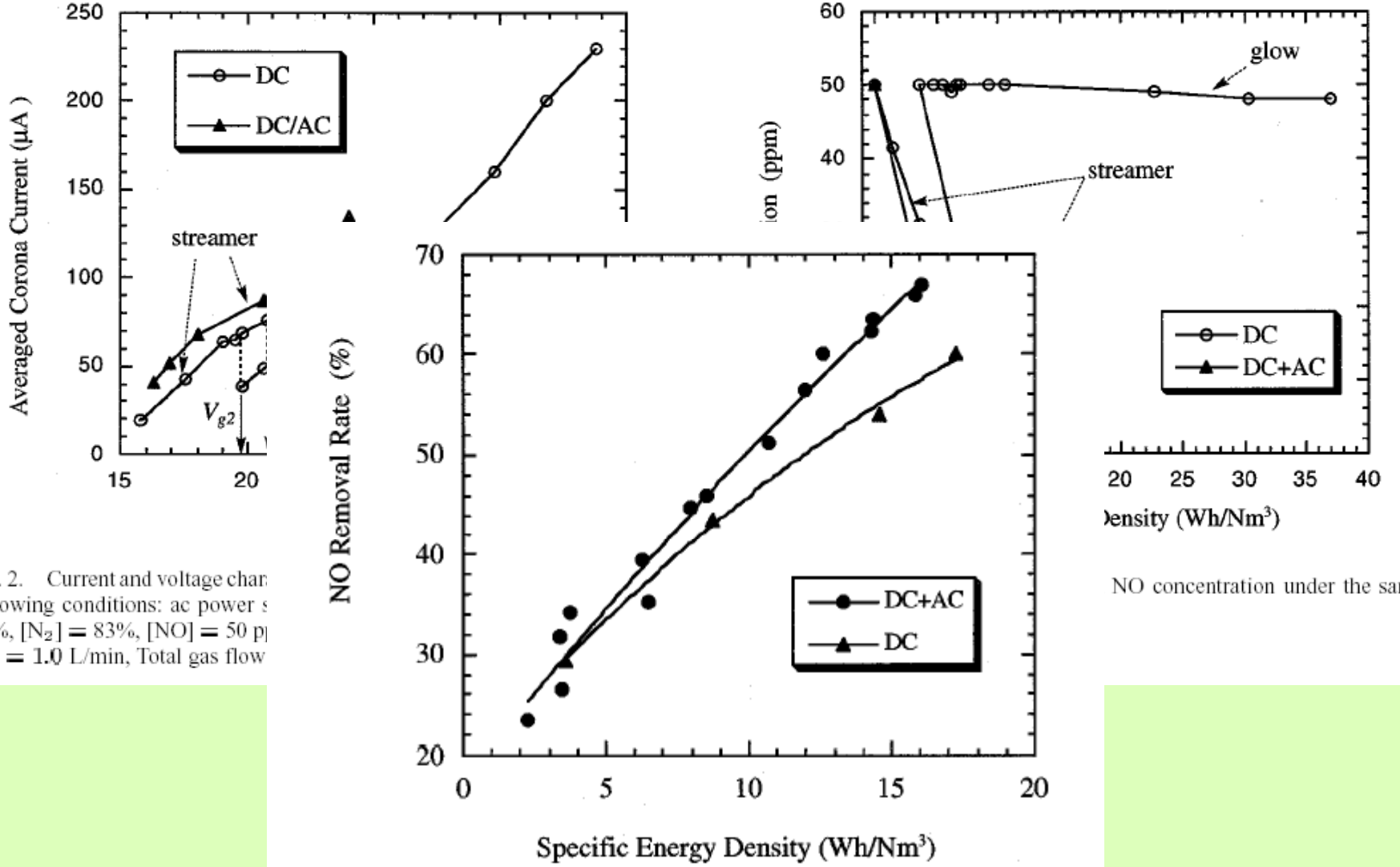


Fig. 2. Current and voltage char
following conditions: ac power s
17%, $[N_2] = 83\%$, $[NO] = 50$ p
$Q_a = 1.0$ L/min, Total gas flow

NO concentration under the same

Fig. 5. Dependence of NO concentration on the type of power supply with a eight nozzles electrode under the following conditions: $V_{PP} = 2.6$ kV, $f = 60$ kHz; $V_{PP} = 3.8$ kV, $f = 40$ kHz; $V_{PP} = 7.2$ kV, $f = 20$ kHz; $V_{PP} = 10$ kV, $f = 10$ kHz; $[NO] = 86$ ppm, $[NO_x] = 90$ ppm, $[CO_2] = 2.7\%$, $[O_2] = 14.8\%$, $[H_2O] = 1.0\%$, $[N_2] = 81.5\%$, $Q_a = 1.1$ L/min, $Q_t = 4.0$ L/min.

Theory of DE SO2

1) gas--liquid-reaction

$$SO_2+(NH_4)_2SO_3+H_2O \Rightarrow 2NH_4HSO_3$$

$$NH_3+NH_4HSO_3 \Rightarrow (NH_4)_2SO_3$$

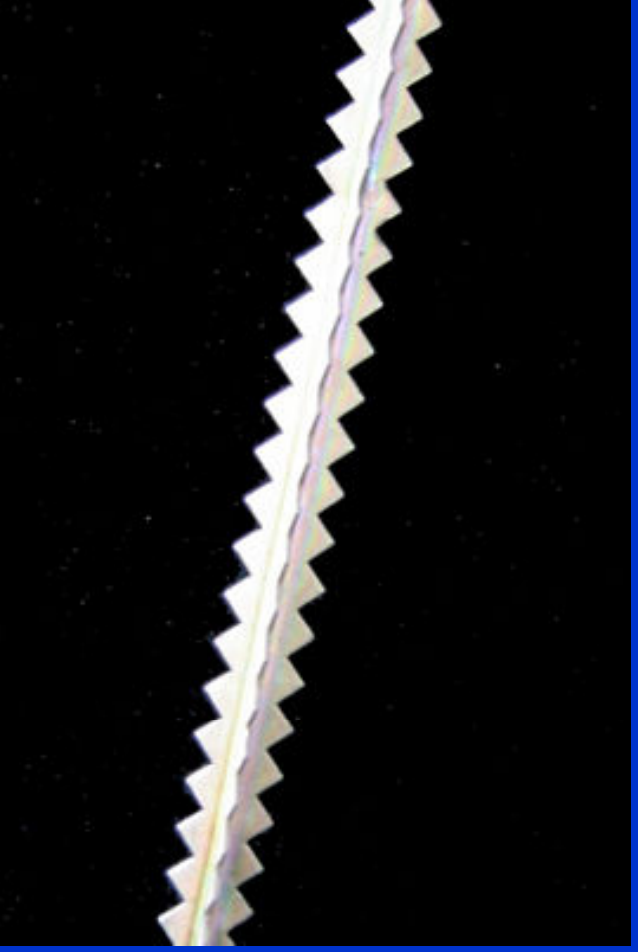
2) reaction with plasma

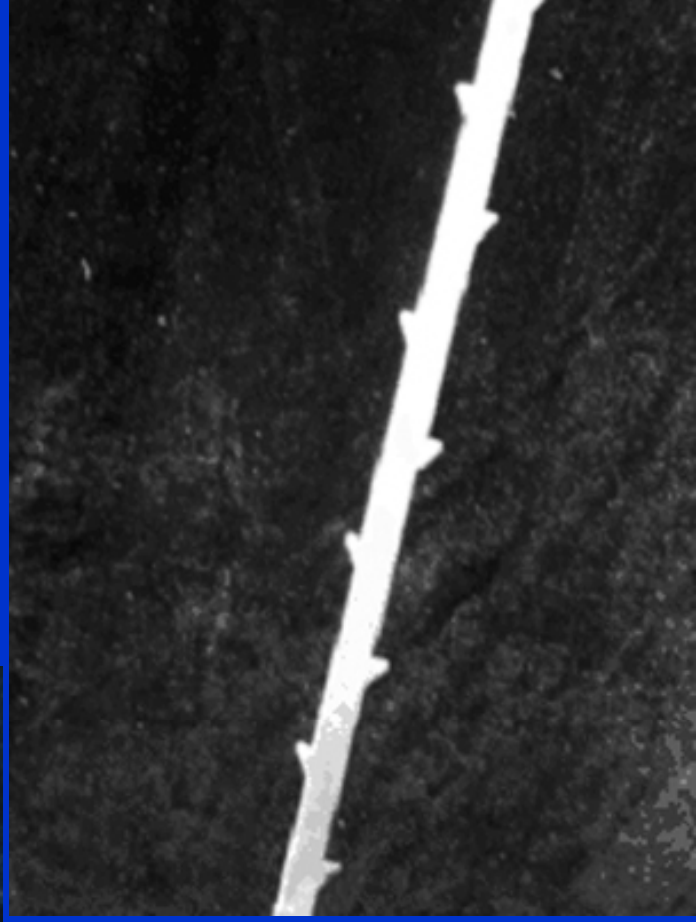
$$O_2\ ,\ H_2O \Rightarrow O,\ OH,\ H$$

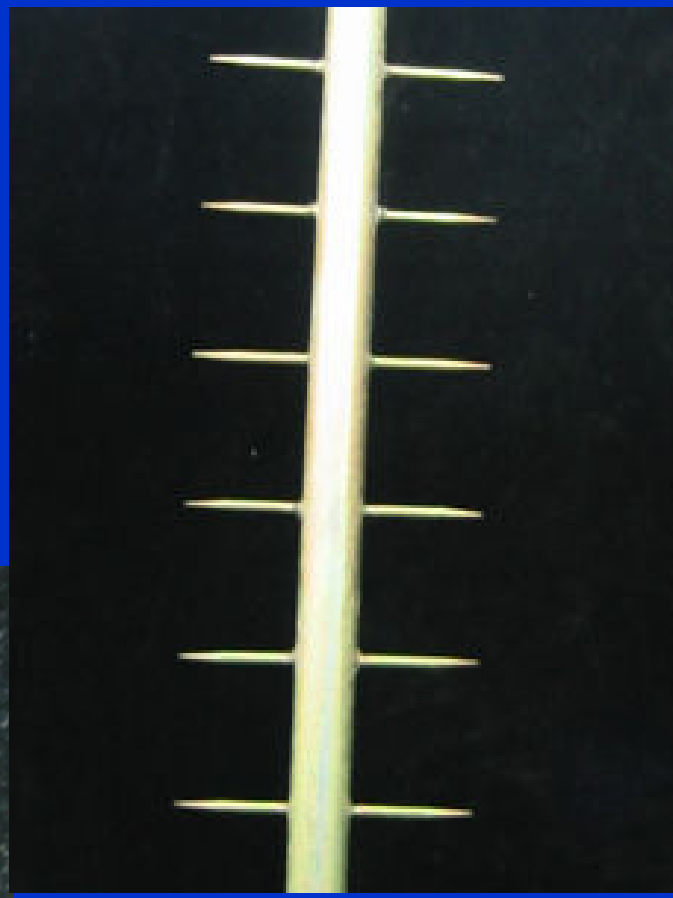
$$SO_2 \Rightarrow SO_3$$

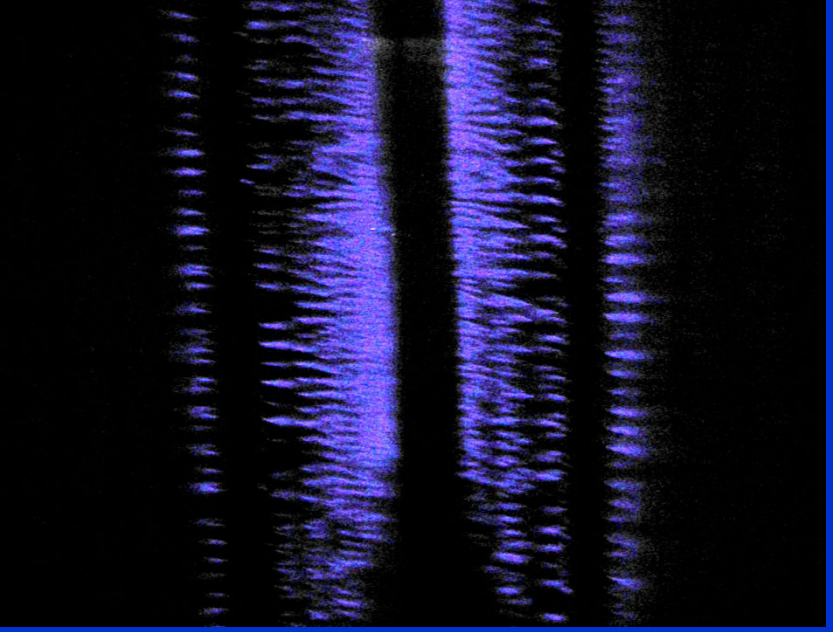
$$SO_3+2NH_3+H_2O \Rightarrow (NH_4)_2SO_4$$

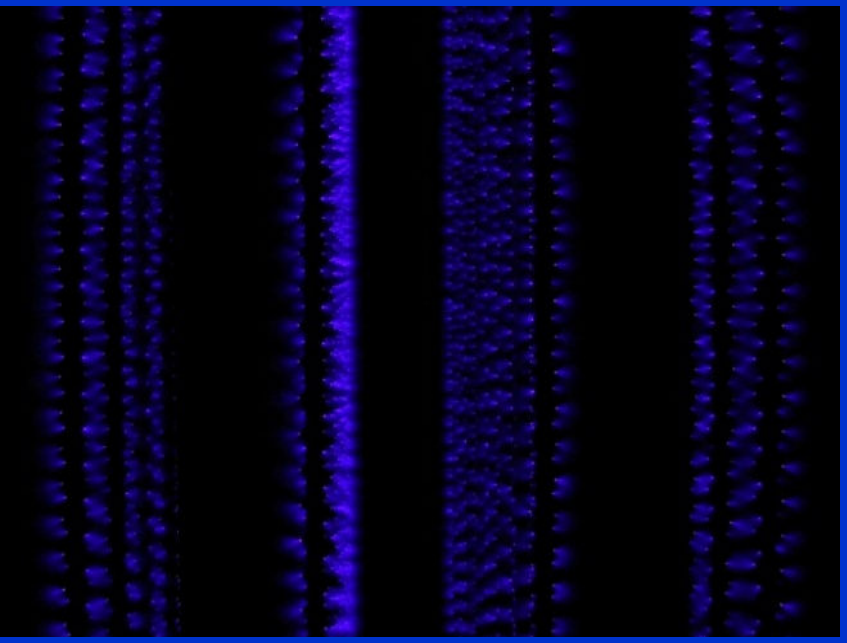
S(IV) => S(VI)

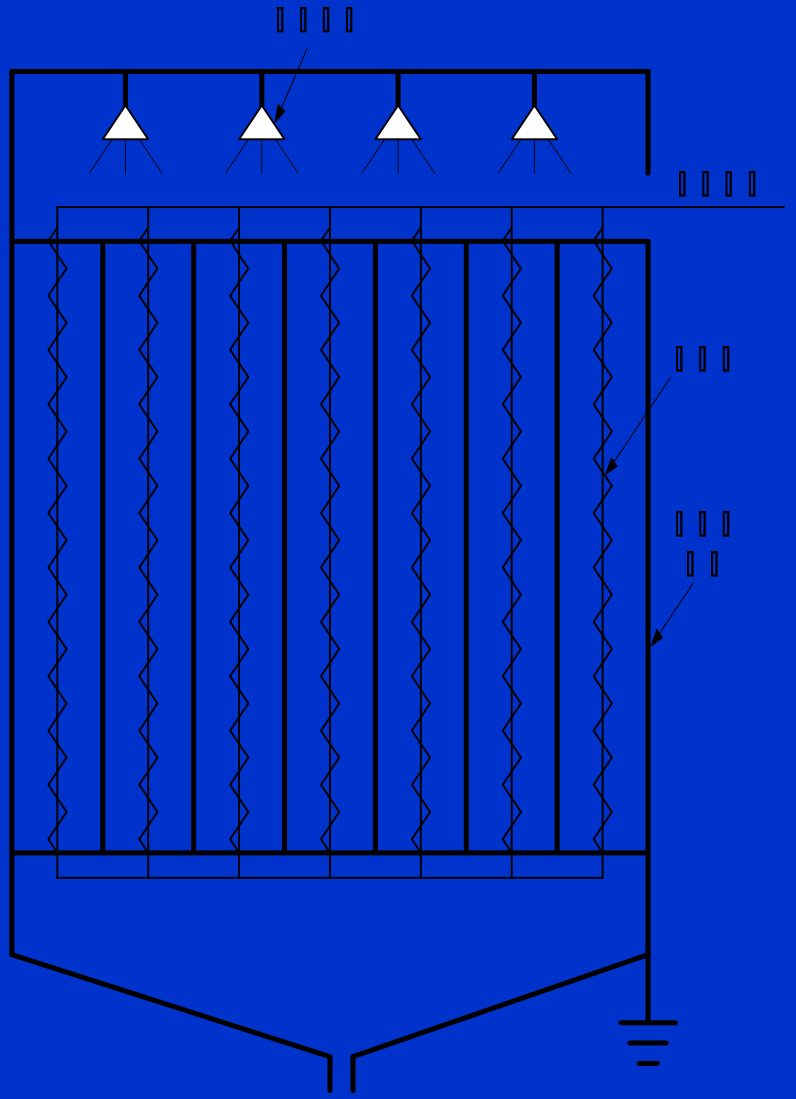






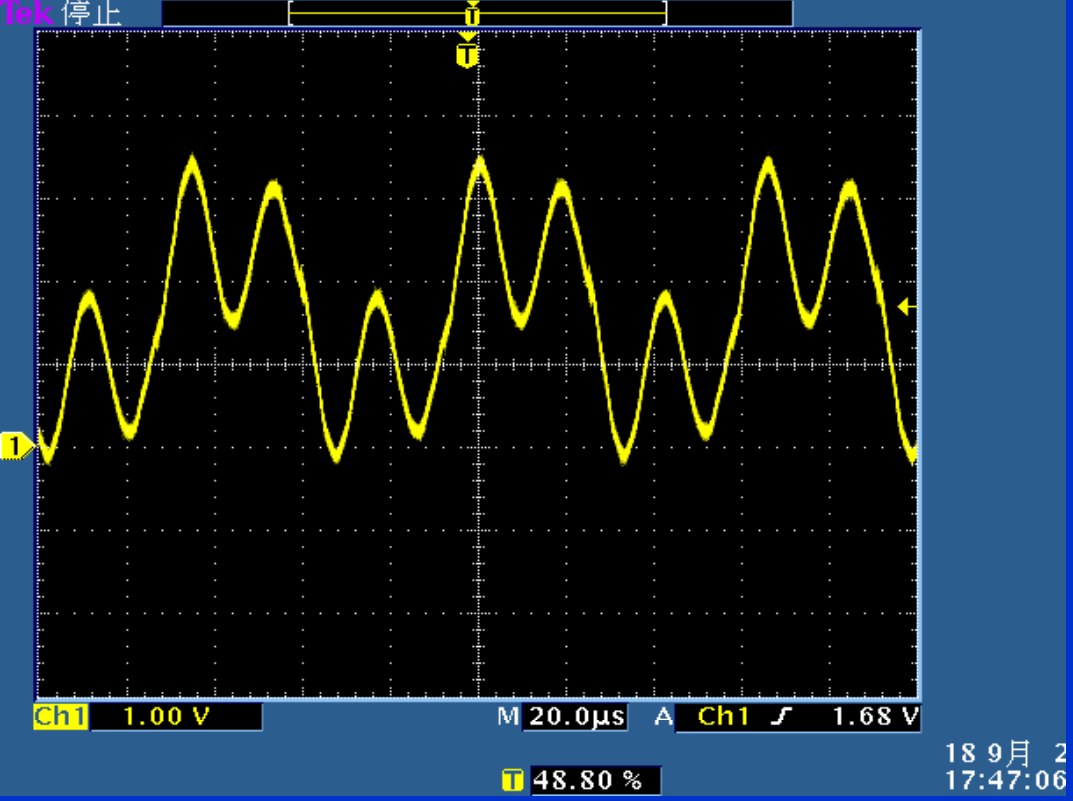


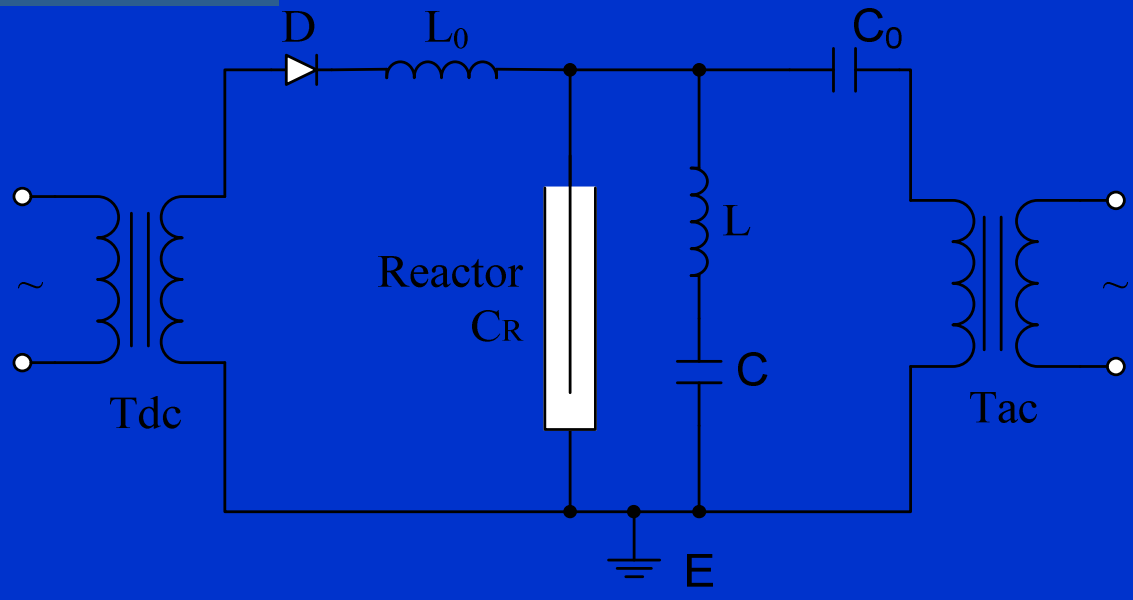


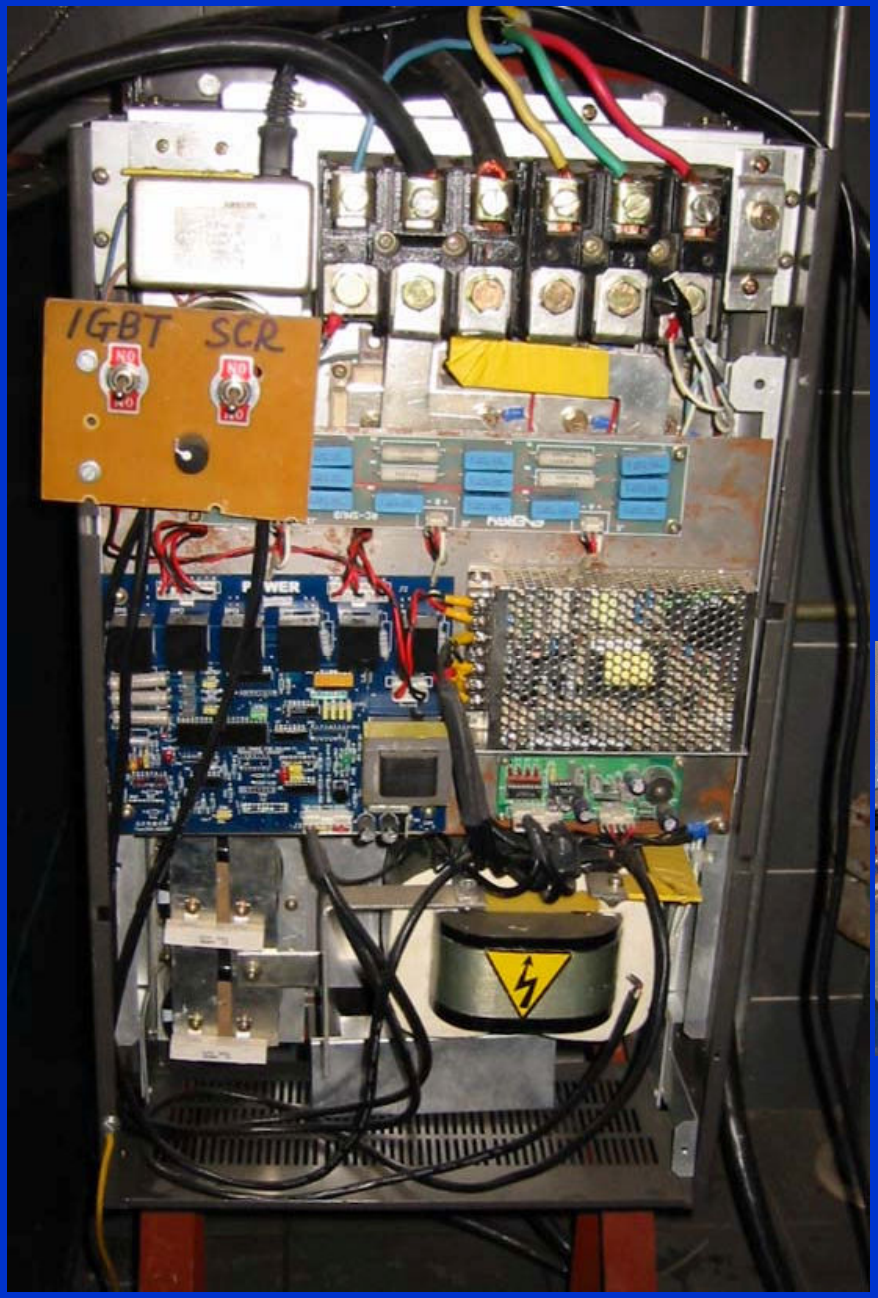


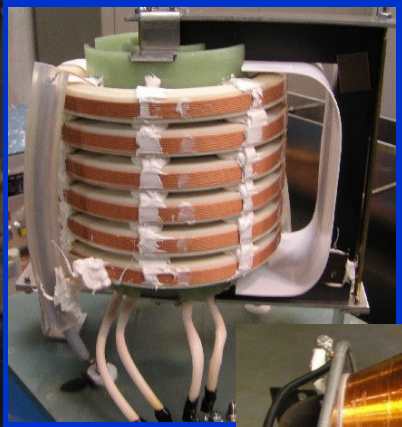
Small scale system in Peking University

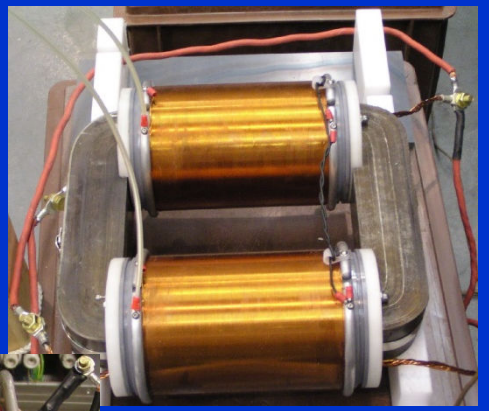
Medium scale system in Tsinghua University

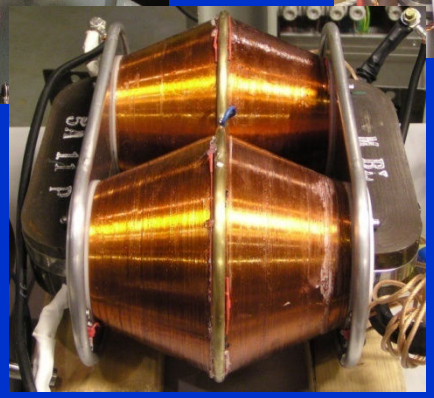

Tek 停止
Ch1 1.00 V
M 20.0µs A Ch1 1.68 V
T 48.80 %
18 9月 2
17:47:06


D
L0
C0
L
Reactor
CR
C
Tdc
Tac
E

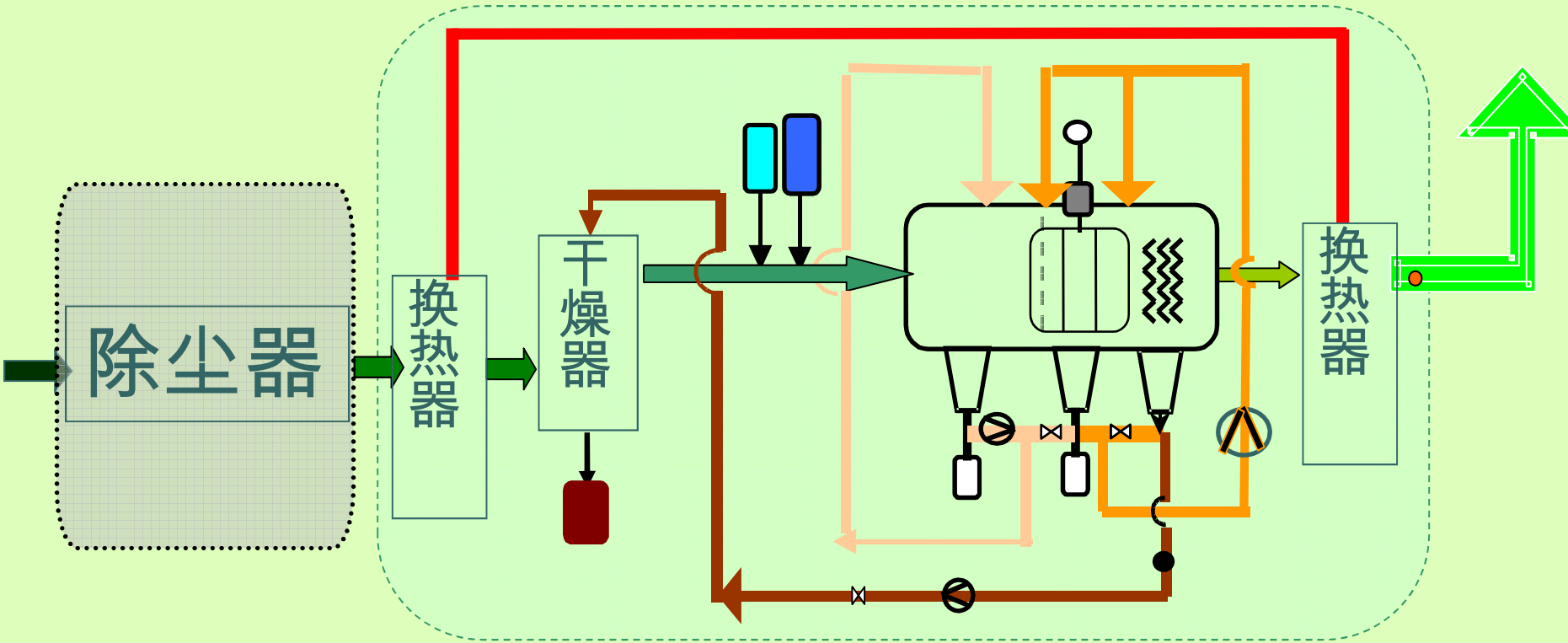

IGBT SCR

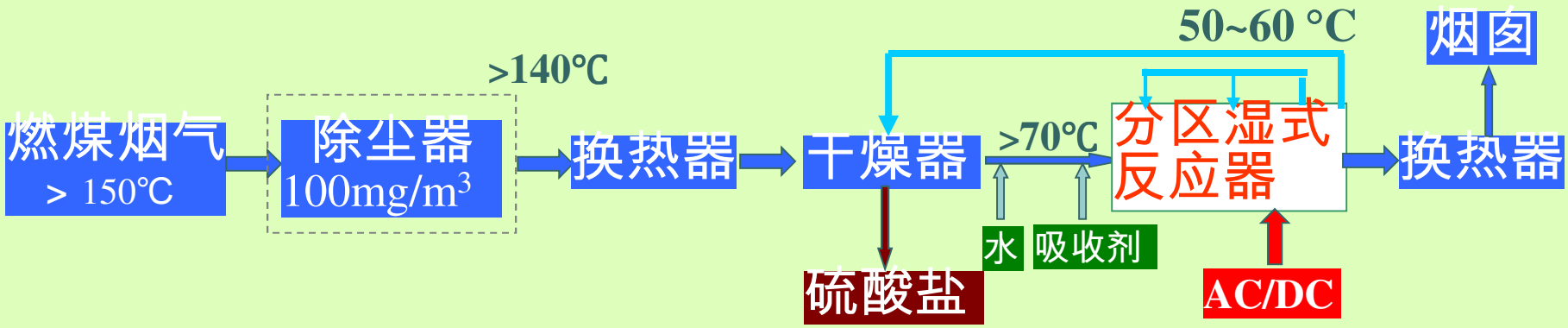




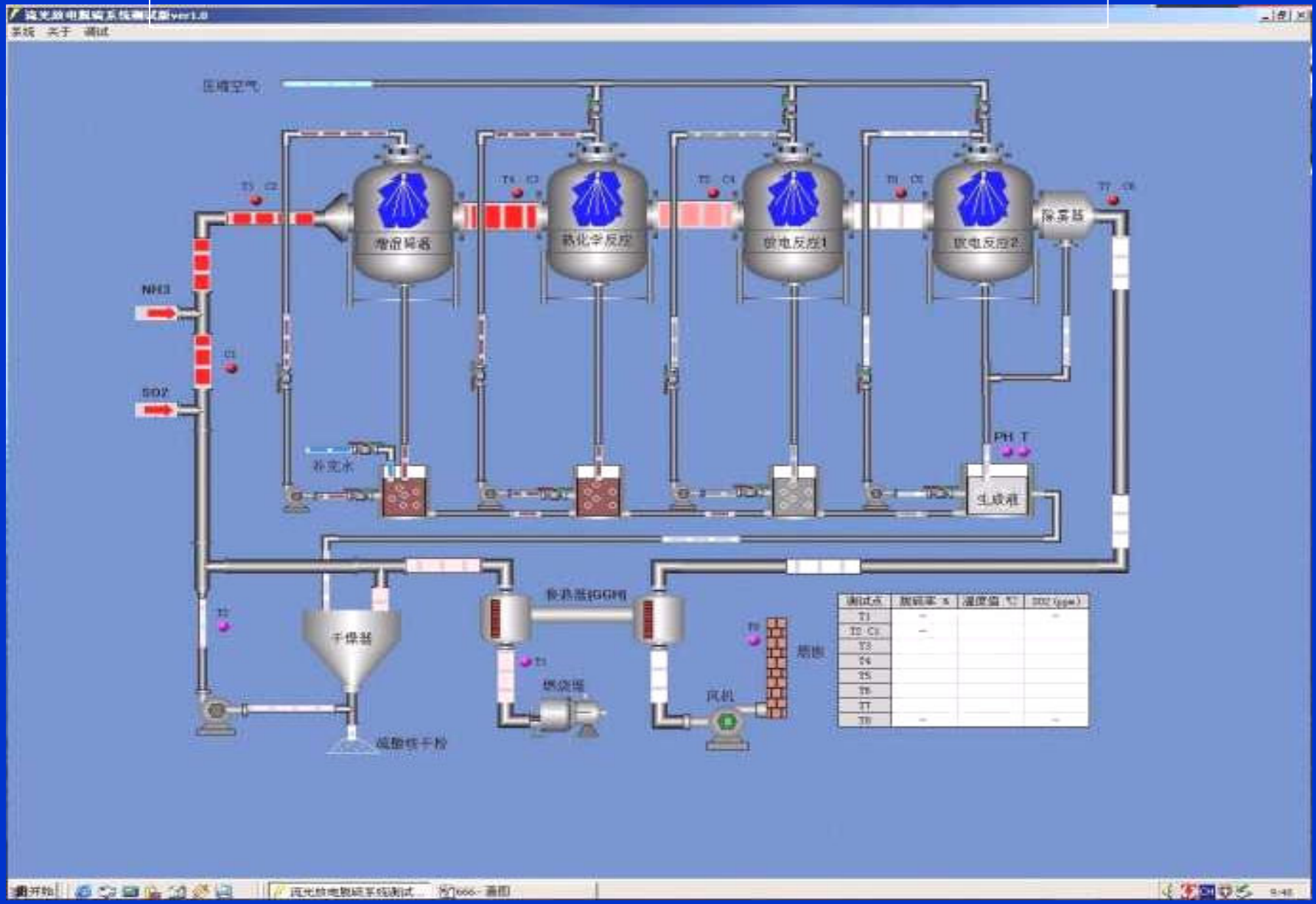


semi-wet flow





semi-wet flow monitor



Large scale system in BJTU

$(NH_4)_2SO_4$

The experiments were carried out on the corona-plasma flue gas $DeSO_2/DeNO_X$ system with a capacity of 12,000 Nm^3/h under the following conditions:

gas temperature at the reactor entrance of 135℃, gas temperature at the reactor exit of 90℃, the power supply's parameters is 40 kVpp/48kHz AC voltage and 40kV DC voltage.

The experiments of $DeSO_2$ and $DeNO_x$ were implemented simultaneously, 98% of SO_2 and 44% of NO_x are removed with an energy consumption of 1.8Wh/Nm^3 and the final products are qualified fertilizer.