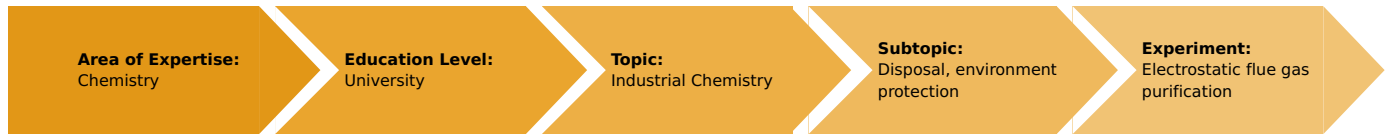


# Electrostatic flue gas purification (Item No.: P1309200)

## Curricular Relevance



### Difficulty



Intermediate

### Preparation Time



10 Minutes

### Execution Time



10 Minutes

### Recommended Group Size



1 Student

### Additional Requirements:

- Lighter

### Experiment Variations:

### Keywords:

## Principle and equipment

### Principle

Smoke consists of particles of solid substances suspended in gas. Fog is made up of suspended droplets. In cigarette smoke, as in many industrial processes, smoke and fog are frequently present together. The removal of particles contained in gases – predominately waste gases – is increasingly gaining in importance, both in everyday life and industrially, because frequently the particles and the substances absorbed on them are toxic. Well known examples are adsorbed polycyclic aromatics on soot particles in diesel exhaust, and dioxins, heavy metals and radioactive elements in waste gases from power stations and waste incinerators. The deposited filter dusts are highly toxic, and must be treated as hazardous waste. The possibilities for purifying gases long known in industry, such as

- mechanical filters (household vacuum cleaner!) as tube or plate filters,
- washing out in trickling towers or gas washers,
- deposition in baffle separators or cyclones,

no longer suffice present day requirements as individual methods. In all modern gas purification processes, coarse cleaning by a method appropriate to the particular process precedes the final step, which is electrostatic purification. In the so-called wet electrofilters, the dust particles are enveloped in a film of moisture and so enlarged. In this way, particles of 0.01 mm size and smaller can be made to deposit. The experimental set-up used here also enables constituents of cigarette smoke to be semi-quantitatively deposited even in quite large amounts, so that they can be extracted with light petrol and be examined.

### Note

Chamber and electrodes can be easily cleaned with a cotton- wool plug impregnated with petrol or methylated spirits.

## Equipment

Position No.	Material	Order No.	Quantity
1	PHYWE High voltage supply unit with digital display DC: 0... ± 10 kV, 2 mA	13673-93	1
2	Frame for complete experiments	45500-00	1
3	Holder for syringes	45523-00	1
4	Insert with joining tube	02615-04	1
5	Gas syringe, 100 ml, with 3-way cock	02617-00	1
6	Panel for complete experimental setups	45510-00	1
7	Apparatus carrier w. fix. magnet	45525-00	1
8	Barrel base PHYWE	02006-55	1
9	Danger sign - high-voltage -	06543-00	1
10	Clamping holder,turnable,8-10mm	45522-00	2
11	Rear-cover for compl.-exp. panel	45501-00	1
12	Nickel electrode,d 3mm,w.socket	45231-00	2
13	Connecting cord, 30 kV, 1000 mm	07367-00	2
14	Glass tube,right-angled, 10 pcs.	36701-52	1
15	Spring plugs, 50 off	45530-00	1
16	Fixing bands,universal,100 pcs.	45535-00	1
17	Glass tube, straight, l=80 mm, 10/pkg.	36701-65	1
18	Rubber stopper 26/32, 3 holes 7 mm + 2 x 1,5 mm	39258-14	1
19	Silicone tubing i.d. 7mm	39296-00	1
20	Petri dish, d 100 mm	64705-00	1
Additional material:			
	Lighter		

## Safety information

Danger! High voltage! Do not touch any metal parts after switching the power supply on! Only hold the electrodes where they are insulated! As long as the electrodes are under high voltage, only work with one hand (keep the other against or near to your body). Warning! Only use connecting cables that are specified to be for high voltage to connect electrodes to the power supply!

## Set-up and procedure

### Set-up

Position the clamping holders on the panel for complete experiments as shown in Fig. 2, and fix the glass apparatus to it as shown in Fig. 1. The dust removal chamber consists of a 23 mm long glass tube, one end of which ends in an attached narrow tube of 8 mm diameter. Fix a right-angled glass tube to this attached tube with a short piece of silicone tubing. The other end of the long glass tube has a socket for a stopper in which a rubber stopper with three bore holes is fitted. Two nickel electrodes protrude through this stopper into the long glass tube, whereby their long ends must be inserted as far as possible through the holes in the stopper.

Connect the long glass tube to the three-way cock of the gas syringe with a short piece of silicone tubing attached to a short straight glass tube. Connect the nickel electrodes to a high voltage transformer (10 kV) with high voltage cables. Do not touch the electrodes for any reason whatever! Prior to the actual experiment, test the set-up by applying a voltage of 10 kV to the electrodes, so that no spark discharge occurs. Fit a short length of silicone tubing to the end of the rightangled glass tube, then carefully insert the mouth end of a cigarette in the free end of the silicone tubing. Fix the lid of a Petri dish on the apparatus carrier with fixing magnets with a rubber band, positioned under the cigarette to act as an ash tray.

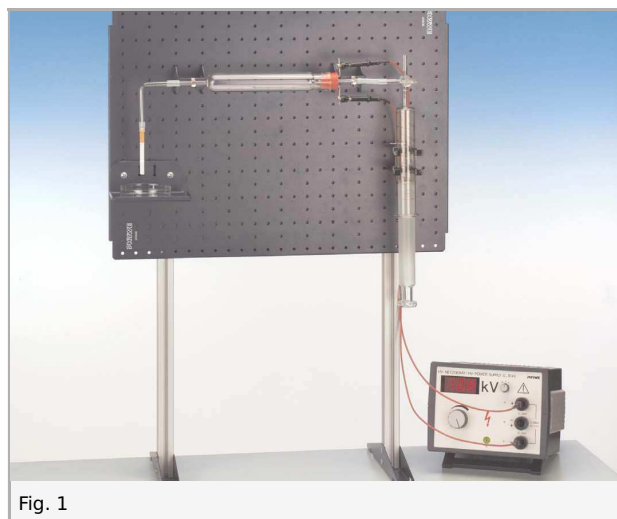


Fig. 1

### Procedure

When the set up is complete, adjust the three-way cock so that only the passage to the chamber is open. Light the cigarette, simultaneously drawing air through the apparatus with the gas syringe. The dust removal chamber is filled with cigarette smoke. Turn the three-way cock to adjust it so that air is all pressed out of the syringe without blowback of the air in the chamber. Again turn the cock so that air can be drawn through the cigarette into the chamber. The gas syringe is now filled with smoke, as can easily be seen by blowing the contents of the syringe into the room air. Switch on the high voltage (10 kV). The smoke in the region of the electrodes very quickly disappears, but is still to be seen in the region away from the electrodes. On continuing the experiment with high voltage applied, cigarette smoke is drawn slowly but continuously through the apparatus by the gas syringe. It can be observed that the smoke is completely deposited in the region of the electrodes, and does not even pass them to go further into the back end of the dust removal chamber, and so also not into the gas syringe.

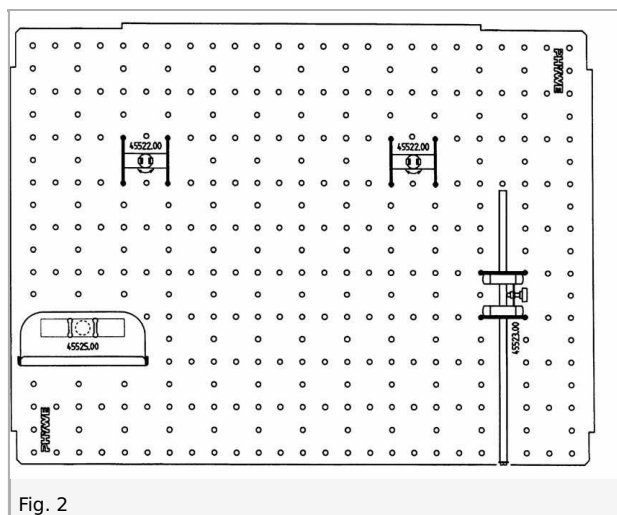


Fig. 2



## Observation and evaluation

In the region of the high voltage field, particles and droplets suspended in the cigarette smoke are charged (ionized) and deposit on the electrodes.