# 4. Electrostatic field of residual electrical charges

## *Objective:*

To measure the intensity of electrical field of electrical charge localized on the surface of material on distance.

## *Theory:*

Application of plastics (very good electrical insulator) is connected with triboelectric effect. Its importance for the environment (especially for interiors) still is not fully cleared up. It is supposed that its most important role is in redistribution of aerosols. Human environment is full of electrical fields from electrical charges localized on many objects or generated by miscellaneous devices. Knowledge of such fields is important for the study of the quality of the environment.

These fields are measurable by use of electrostatic voltmeters. One of them is the electrostatic voltmeter known as field mill. It is created from insulated asterisk's shaped electrode, fig. 1 and rotating asterisk shaped grounded electrode. If this voltmeter is in the electrical field, then the opposite electrical charge is induced at the insulated electrode. The charge is drained to the ground over a resistor R, fig. 2. When the insulated electrode is hidden behind rotating grounded electrode, then the field is interrupted. This situation is periodically repeated and we can read out alternating voltage from the resistor. Its amplitude is proportional to the intensity of measured electric field. The waveform of the signal from the voltmeter is given by the shape of both electrodes. If the shape of the electrode is given by equation (1), (the polar coordinate system is used, *N* is a number of leafs, other parameters are described in figure 1), then the output is sine wave signal. The schematic drawing of the set-up is illustrated in fig. 2.

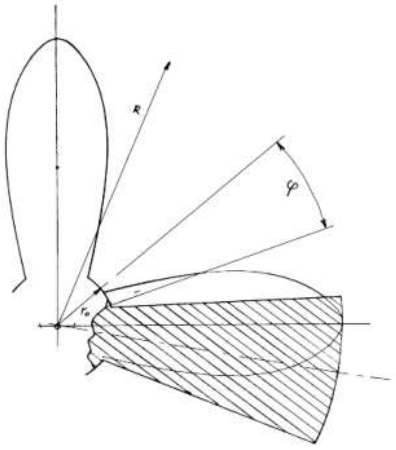


Fig. 1 Shape of the electrodes

$$r = \sqrt{r_0^2 + (R^2 - r_0^2)\cos(N\varphi)} \qquad (1)$$

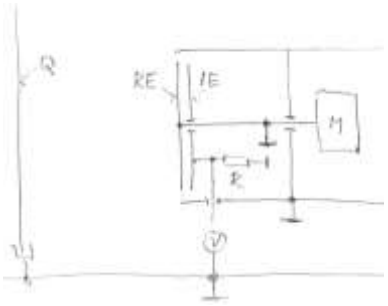

Fig. 2 Schematic representation of the field mill voltmeter

## *Instruments:*

- Field mill voltmeter, base board, multimeter, plastics samples.

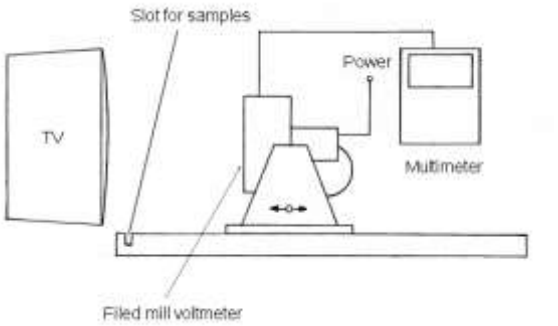


Fig. 3 Photograph and schematic representation of the set-up.

## *Procedures:*

- Place metal plate into the slot for samples. Connect it with the ground of field mill, which is in the vicinity of the plate. Turn on field mill. Check the minimum signal on the voltmeter.
- Remove the metal plate from the slot. Place plastic samples (polymethylmethacrylate, polyvinyl chloride, polypropylene) into slot subsequently and measure AC voltage (!convert it to electric field intensity! 1 mV=42.9 V/m) with a different distance of field mill.
- Results plot into graphs. (!Electric field/distance graph!).

## *Results:*

## *Conclusion:*

## *Questions:*

- Suggest a method for determining the polarity of the surface charge.
- How would you determine the conversion constant for the voltmeter voltage to the intensity of the electric field?