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AC FLASHOVER VOLTAGE IN VACUUM FOR DIFFERENT ELECTRODE DIAMETERS AND DIFFERENT PRESSURES

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Application of vacuum insulation in cryo-installations, for example cryocables, reqiures investigations made on specimens and laboratory arrangements which would be very close to those met in practice.

To explain the influence of arrangement parameters on flashover voltage in vacuum the following investigations were made in the first stage: measurements of the influence of the electrode diemeters and of the pressure on the flashover voltage of ceramic spacer insulators. The pressure influence investigations were also aimed to clear some literature problems on the subject,

Measurements were made with stainless steel electrodes with a profile close to the Rogowski profile, in a stainless steel vacuum chamber with a glass high voltage bushing insulator. The ceramic spacer insulator had the diameter 8 mm and height 5,7 mm. The measuring voltage was ac 50 Hz. The electrodes had the diameter ranging from 3,2 to 190 mm: the measurements were performed at pressure 10^{-5} torr with symetric electrodes. The results are shown in Figure 1.

Every point on the curve is a mean value of 5 measurement series each of 20 flashovers from which last 20 values were taken to the counting. It is seen from Fig.1. that the highest strength is achieved for electrodes which have their flat part of the same diametr as the specimen. Increasing

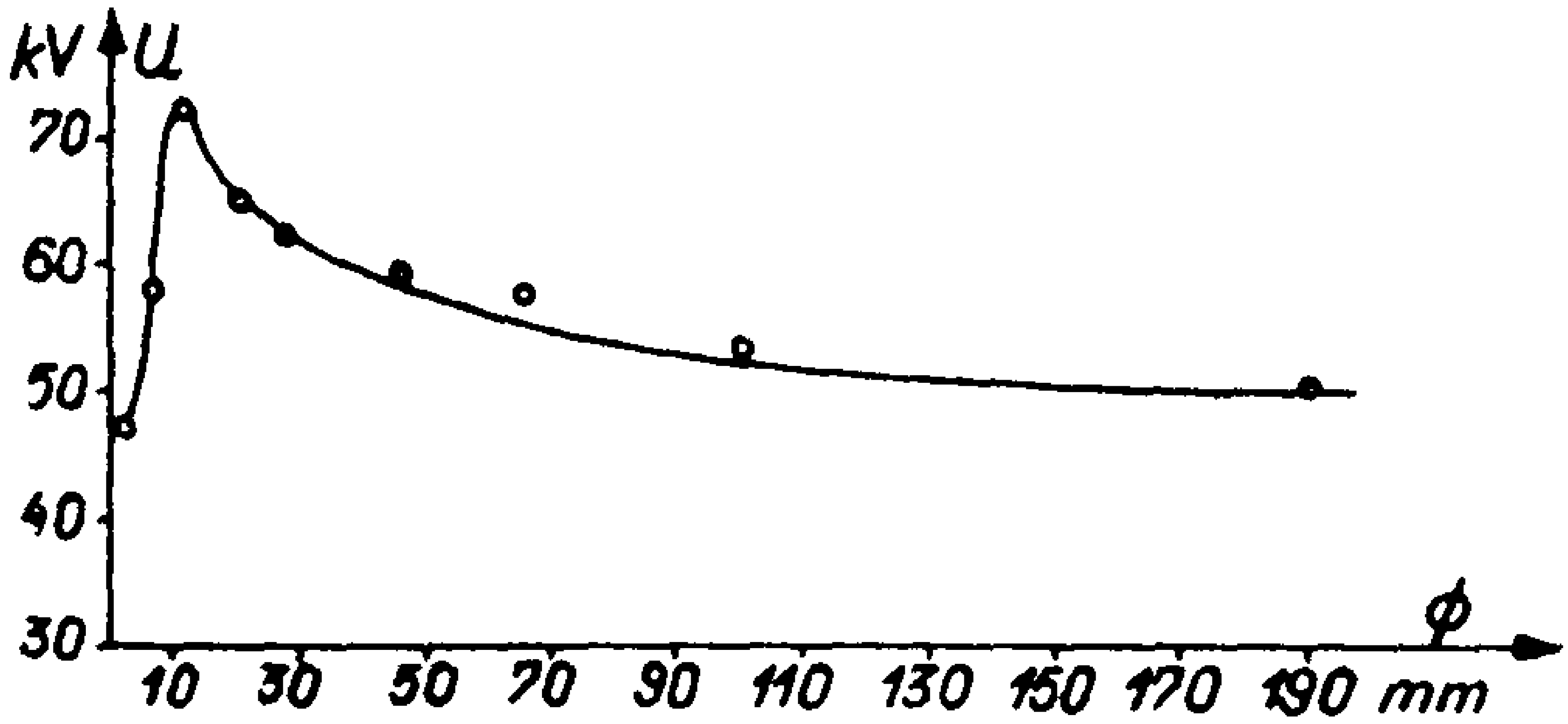

Figure 1. Flashover voltage /peak values/ on the surface of radioceramic insulator / Ø 8 mm, h = 5,7mm/ versus electrode diameter

and decreasing of the electrode diameter causes a decrease of flashover voltage. The curve tends to a saturation value ehen the diameter is increased.

Investigations of the pressure influence are shown in Figure 2. The results include pressure values of the range $8,6 \cdot 10^{-5}$ torr - $2 \cdot 10^{-3}$ torr. The measurements were performed in three cycles:

a/ when increasing pressure for the same specimen

b/ when decreasing pressure for the same specimen

c/ for chosen pressures; for each value of pressure another specimen was tested.

For each cycle several series of measurements were made so that every point on a curve is a mean value several tens of results.

In this study the increase of flashover voltage for pressures in the range 10^{-3} torr - 10^{-4} torr, was not achieved / 1, 2, 3, 4 /. As could be presumed the strength decreases for pressures lower than 10^{-3} torr, rapidly decays at pressures $5 \cdot 10^{-3}$ torr, and the discharge develops in rarefied gas.

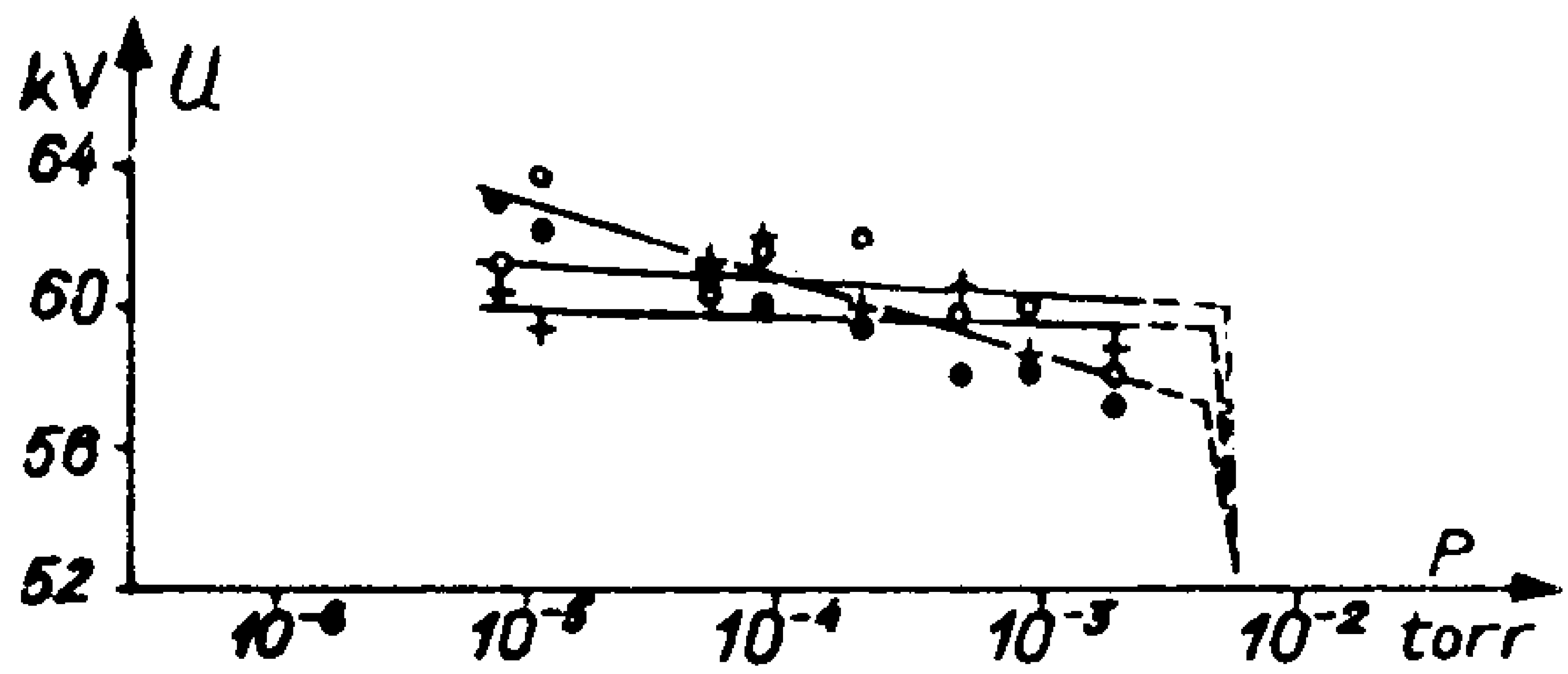

Figure 2. Influence of pressure on the vacuum surface flashover voltage: x - "a" cycle; • - "b" cycle; o - "c" cycle; electrode diameter 46 mm /stainless steel/, insulator Ø 8 mm, h = 5,7 mm

It is seen from Fig.1 and 2 that a small increase of flashover voltage arises for the lowest pressures.

Confidence limit for both investigations was always lower then 1,8 kV for confidence level β = 0,95.

It may be concluded from the present results that a disadvantageovs influence of the surface magnitude of working electrodes may arise while disigning installations with vacuum insulation with spacer insulators. In this case increase of electrode diameter from 8 mm to 190 mm causes 31 % decrease of flashover voltage. Major part of the decrease, falls to diameters up to 70 mm afterwards the decrease it insignificant. However in practical installations with big electrode surfaces and short distance between them one has to consider a reduction of strength compared to the one in laboratory conditions. This influence is also made known by Slivkov /5/.

No major change of strength was noticed for pressures in the range 10^{-5} - 10^{-3} torr. Even if an increase of strength was found for higher pressures /as suggested by some authors/ it would seem dangerous for power installations to work in such conditions because any sway from dynamic balance could lead to discharges in a rarefied gas.

So it seems proper to design installations for lower pressures eg. 10^{-5} - 10^{-6} torr in spite of greater technical difficulties, as already suggested by Graneau / 6 /.

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