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Receiving and the capacitive profile of the capacitors arrangements on the base of natural rubber with the addition of $SrCl_2$ or $ZnCl_2$ and the active carbon

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ABSTRACT

In an easy way presented, how to receive cheap capacitive materials with changeable capacitance depending on demand. The examination of capacitive properties /characteristics/ has been determined in temperature of 20 °C. Average range of the capacitance oscillated between 23 and 41 F/g. The capacitive arrangements were marked on the arrangements with resistors and the decades capacitors.

Keywords: natural rubber (NR); organic capacitors; conductive polymers; $SrCl_2$; $ZnCl_2$

1. INTRODUCTION

Super-capacitors are known from many years. They are mainly used as the materials – “accelerators” in car engines, giving more power. Also, the super-capacitors are widely used in electrical and electronic engineering. Receiving and the capacitive profile of the organic capacitors for one gram of composite as a capacitor filler have been presented in this article.
In the present paper, a method is presented of obtaining polymer electrolytes from natural rubber. As a factor inducing electrical conductivity of polymer systems, $SrCl_2$, $ZnCl_2$ (manufactured by Chempur®, Poland) were used as well as active carbon (also manufactured by Chempur®, Poland) with a 900 m^2 active surface per one gram of active carbon [1-26].

Natural rubber (*Hevea brasiliensis*), which was used for obtaining polymer electrolytes, originated from a Para rubber tree plantation in Ranni, Kerala State, south-western India. Natural rubber (NR) was collected and taken down from a Para rubber tree and imported to Poland in June 2006

2. EXPERIMENTAL – RECEIVING THE CAPACITIVE ELECTROLYTES

2. 1. Synthesis of the system: NR + $SrCl_2$ or $ZnCl_2$ + active carbon

2. 1. 1. Stage 1 – dissolution of rubber latex with active carbon addition

Natural rubber (*Hevea brasiliensis*), is found in the form of rubber latex and oxidates quickly in the air, producing an elastic and stretchy caoutchouc (India-rubber). In order to avoid this process (since India-rubber dissolves more easily in the form of rubber latex), it was immediately added to toluene (99 % pure). Toluene (manufactured by Spectrum Chemicals, Edayar, Cochin-683 502, India, Code: T 0105) was bought straight before collection of natural rubber in India. Natural rubber latex, preserved this way, was imported to Poland. To work out a method of natural conductive rubber synthesis, it required in the first stage to precipitate rubber latex from toluene and to dissolve it again in toluene in order to make strictly specific mass recalculations. For precipitating the rubber latex, methanol (98 %, manufactured by Chempur®, Poland) was used. Rubber latex can be dissolved in petrol or benzene, but it best dissolves in toluene. For this purpose, toluene (99.5 %, manufactured by Chempur®, Poland) was used. Proportions of rubber latex dissolution are as follows: 3 grams of natural rubber were added to 40 cm^3 of toluene (Fig. 1).

Such a rubber solution was left for 12 hours, shaking it from time to time. After 12 hours, natural rubber was again dissolved in toluene of a known concentration and of white oily consistency. Such a natural rubber solution was supplemented with active carbon (powdery form) in the amount of 0.5 g, 1 g, 1.5 g, 2 g, and 2.5 g.

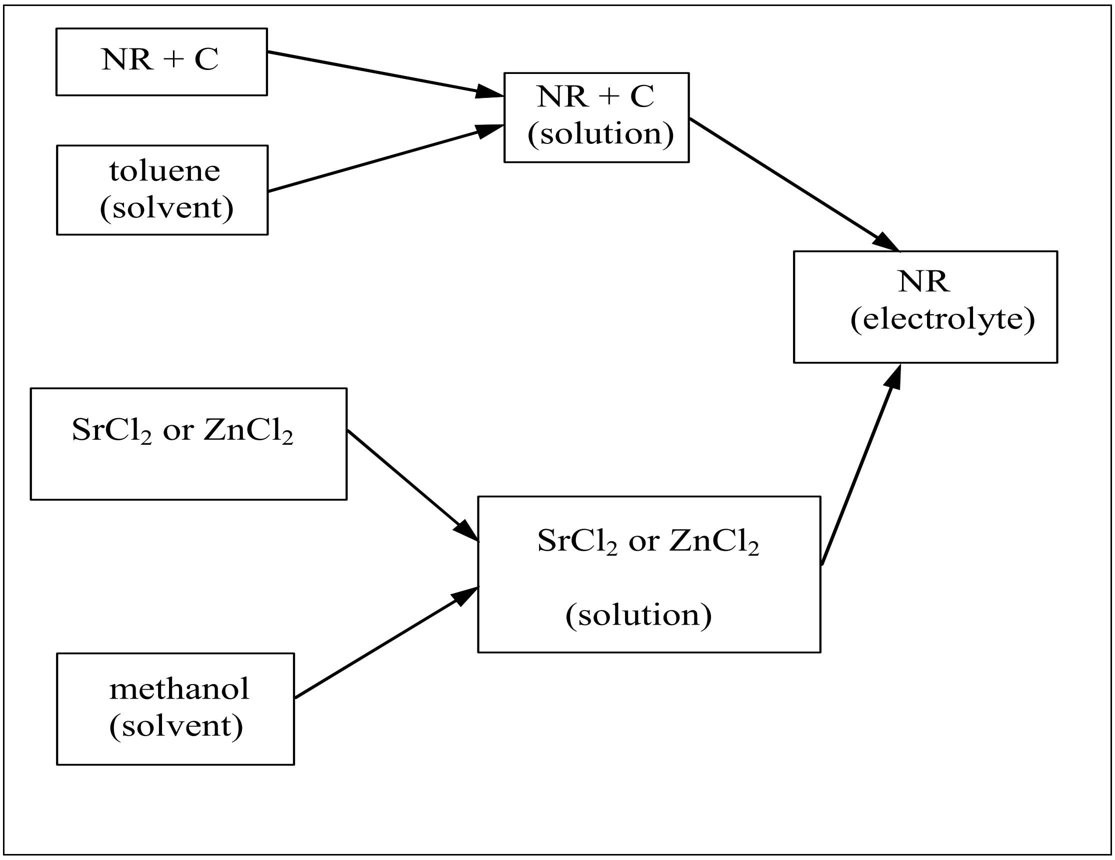

Fig. 1. Preparation of conductive natural rubber (NR)

2. 1. 2. Stage 2 – synthesis of polymer electrolyte (capacitor)

Before obtaining a rubber electrolyte with active carbon addition, a maximum amount of $SrCl_2$ or $ZnCl_2$ possible for adding was determined. This amount was assayed and it equaled to 5 grams of $SrCl_2$ or $ZnCl_2$. After adding a larger amount than 5 grams of $SrCl_2$ or $ZnCl_2$, problems related to precipitation of rubber electrolytes in the form of gel from this solution occurred in all systems. These problems consisted in a non-homogenous form of gel.

$SrCl_2$ or $ZnCl_2$ in the amount of 5 grams dissolved in 40 cm^3 methanol and added to the NR solution prepared earlier with addition of active carbon.

After stirring, rubber electrolyte precipitated from the solution almost at once. Such a rubber electrolyte system is left for one day after removal from the solution. After one day, the rubber system is subjected to electrical conductivity testing (capacitor) (Fig. 1).

3. THE METHOD OF EXAMINATION OF CONDUCTIVITY AND THE CAPACITIVE PROPERTIES OF COMPOSITE ARRANGEMENTS

In order to mark out the specific conductivity of received arrangements, they have been subjected to examinations with the use of alternating current. For that, the following apparatus have been used (Fig. 2):

- the generator of alternating current of type: HEWLETT PACKARD 33120A 15MHz FUNCTION/ARBITARY WAVEFORM Generator
- Multimeter of type AGILENT 3458a 81/2 DIGIT MULTIMETR
- Oscillograph of type HEWLETT PACKARD infinium oscilloscope 500 MHz, 1Gsa/s

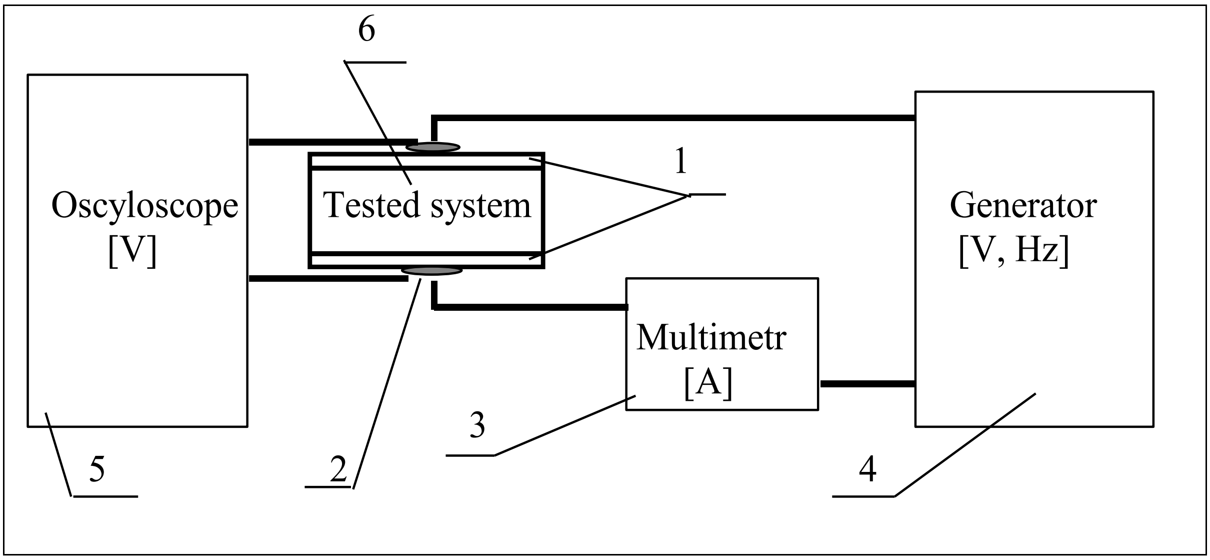

Fig. 2. Measuring diagram for the conductivity of tested polymer system: 1 – copper plates, 2 – conductor and copper plate junction, 3 – multimeter, 4 – alternator, 5 – oscilloscope, 6 – polymeric electrolyte

Settings of the conductive polymers were examined on copper plates. These copper plates have been earlier cleaned with four-chloride-carbon (CCl_4) and rinsed with hot water.

Next, they have been subjected to four hour long chemical polishing within the solution with the following composition:

- H_3PO_4 (80 %)	500 cm^3 (cubic centimetres)
- CH_3COOH (icy)	300 cm^3
- HNO_3 (60 %)	200 cm^3

To such prepared two copper plates with the area of 0,88 cm^2 (square centimetres) each, the following arrangement (setting) has been introduced: polymer + $SrCl_2$ or $ZnCl_2$ + active carbon with the thickness of 0,1 cm.

Below, has been presented the arrangement scheme for the measurement of capacitors properties of polymers composites. Figure 3 presents typical electronic diagram of such setting /arrangement/.

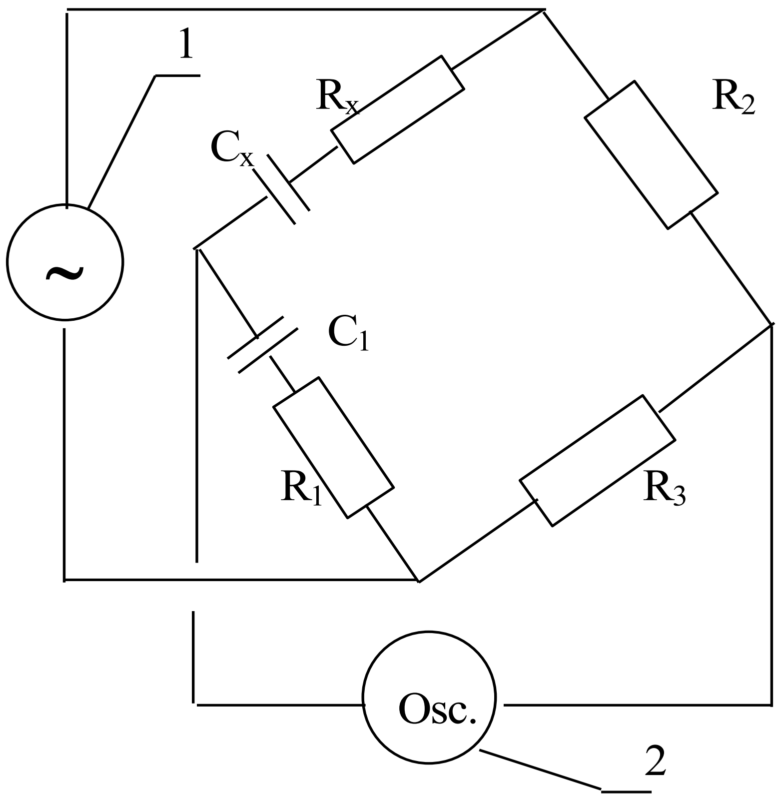

Fig. 3. Electronic diagram arrangement of alternating current for examining capacity of polymers arrangements /settings/:
1 – voltage 1,5Vpp for frequency of 1 kHz, produced by functional generator made by *Hewlett Packard 33120A,* 2 – setting on the oscillograph *Hung Chang-Oscilloscope 3502C* (20MHz), $R_{1\text{-}3}$ – resistances set-up on *decades resistances of type OD-1-D7a,* C_1 – set capacitance on *the decade capacitor of type CD-5d*

4. SUMMARY FINDINGS

In the following table 1 the capacitive values expressed in Farads have been presented, depending on the amount of active carbon added to the rubber electrolyte.

Table 1. The outcomes /results/ of the measurement, which are determining the capacity of the composite arrangement for the values from 0,5 to 2,5 grams of the active carbon, with the constant value of $SrCl_2$ or $ZnCl_2$ in the amount of 5 grams.

The chemical relationship	**The quantity of the active carbon [g]**				
	0,5	1,0	1,5	2,0	2,5
	The capacity of the arrangement [F/g]				
$SrCl_2$	23	27	33	36	39
$ZnCl_2$	24	28	36	39	41

Above, the capacitive profile of the polymer composite has been presented. The active carbon admixture range in regard to polymer arrangement, causes changeable /variable/ capacitive values. If the added active carbon increases, the capacitive properties increase proportionally, almost in linear way. It can be assumed, that such polymers arrangements with the capacitors properties, are having the predictable capacities, depending on the amount of the active carbon added.

5. CONCLUSIONS

Received, from the natural rubber the capacitive arrangements with the addition of $SrCl_2$ or $ZnCl_2$ and active carbon can be used as materials in electronic and electrotechnical industry.

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