## 4. CARBON PRODUCTS

Activities in the area of carbon technology covered research and development work on (i) carbon fibres , (ii) arc carbons , (iii) midget electrodes , (iv) electrographitized grades of brushes , (v) carbon mixes , and (vi) carbon microphone granules.

### 4.1 CARBON FIBRES

**Progress**

Carbon fibres were developed using PAN (Poly Acrylo Nitrile), viscose rayon, and pitch precursors.

*PAN :* Efforts were directed towards drawing of carbon fibres in continuous stretches, and encouraging success was achieved in development of fibres using PAN precursor. Two imported PAN precursors were carbonised, yielding the following results :

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|---|---|
| PAN-Courtella, UK | Strength : $300 \times 10^3$ psi |
| | Modulus : $30 \times 10^6$ psi |
| PAN-Beslon, Japan | Strength : $250 \times 10^3$ psi |
| | Modulus : $25 \times 10^6$ psi |

*Viscose Rayon :* Work was continued on carbon fibres using viscose rayon produced by M/s Century Rayon. It was possible to produce carbon fibres with a strength of $80 \times 10^3$ psi and a modulus of $7—8 \times 10^6$ psi on a 10-hour batch process.

*Pitch Fibres :* Efforts were primarily concentrated on drawing fibres from petroleum pitch, and carbonizing them. Softening point of about 200°C for drawing pitch fibres by melt spinning was obtained from a raw pitch of 80°C softening point, by treatment in nitrogen atmosphere around 400°C. The study of viscosity variation of pitch with temperature showed that between the temperature range 300°C to 400°C the viscosity was minimum, and meso-pitch, which is the real precursor for carbon fibres, was formed. The modulus and the strength of the carbon fibres developed were $7 \times 10^6$ psi and $100 \times 10^3$ psi respectively.

*Characterization of Fibres :* Extensive characterization studies were carried out on PAN-based carbon fibres. The properties of the ultimate carbon-fibres depend very much on the transformations that take place during oxidation. This was confirmed by characterization studies. During the year, special emphasis was laid on the studies on (i) the influence of the time of pre-oxidation on the tensile strength of fibres under constant load conditions , (ii) the influence of the change in

the length of the carbon fibres on their tensile strength , (iii) X-ray low angle scattering of carbon fibres to study the size and surface area of the pores in carbon fibres , (iv) surface area determination , and (v) the behaviour of carbon fibres during adsorption and desorption.

### 4.2 ARC CARBONS

**Progress**

The production of cinema arc carbons by the NPL-licencees increased considerably during the year. The details of the process know-how for rotating carbons were also worked out and passed on to the licencees of arc carbons, for commercial exploitation.

### 4.3 MIDGET ELECTRODES

**Progress**

The Laboratory continued processing midget electrodes and sending them to a few battery manufacturers. A new centreless grinder for automatic grinding was also commissioned during the year. Supply of electrodes produced at the experimental pilot plant, to M/s. Koman Industries, Kaninad, who have taken the know-how for dry cell manufacture from the Central Electro-Chemical Research Institute , Karaikudi , was continued. The process know-how for midget electrodes was released to M/s. Shreyas Engineering & Chemical Industries Ltd, Bangalore. M/s. Britelite Carbons Limited, Bombay, continued production of the midget electrodes with the NPL know-how, and the samples of the firm were approved by the National Test House, Calcutta, and M/s. Jesons Electronics Ltd., New Delhi. The firm also supplied a few lakh pieces of midget electrodes to the battery manufacturers.

### 4.4 ELECTROGRAPHITIZED GRADES OF BRUSHES

**Progress**

Automobile grades of brushes were developed successfully using graphite scrap which is available in abundance. These brushes required heating upto 2000°C , and their performance was found quite satisfactory.

### 4.5 CARBON MIXES

**Progress**

During the period under report, studies were carried out to investigate the effect of pressure , particle size and binder in moulding , on the final properties of these moulded products after baking .

## 4.6 CARBON MICROPHONE GRANULES

**Progress**

Techniques were developed for processing of raw materials for making carbon granules which are vital for the telephone communication systems. With precise control of temperature and environment, which form critical parameters, cheap raw material was successfully converted into a sophisticated product having negligible porosity and optimum pyro-electric deposition on a partially graphitized interior.

The manufacturing process essentially consists of heat treatment of a selected type of anthracite coal in an inert atmosphere in the range of 1000-1200°C, giving it then an oxidation treatment at a certain temperature followed by a mechanical agitation to make it stable, and finally elutriating and sieving.

The granules developed at the Laboratory underwent vigorous testing according to stringent specifications and international standards, and were found not only to be satisfactory by the Indian Telephone Industries and the Defence authorities, but also comparable to the imported granules in all the properties.