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Singapore Industrial Research Unit

By A. Rajaratnam, Director

Introduction

Singapore, a small island with an area of 220 square miles and a population of about 1.8 million, has more than 2 500 industrial enterprises of one form or another. They range from the traditional industries producing food-stuffs, such as beehoon (rice noodle), and the processing of raw materials like timber, rubber and rattan, to the new pioneer industries, such as oil refining, steel milling, electrical and electronic assembling, textiles, pharmaceuticals and chemicals manufacturing.

The majority of these firms are quite small, with little spare capital and limited technical resources. Often it is not economically feasible for these firms to have within their own factories the complete range of equipment, laboratory facilities, technical personnel and other resources requisite for tackling all the technological problems associated with a developing industry. If the local firms are to prosper in a competitive home and foreign market, all the technological problems associated with raw materials, machinery, waste product utilization, process control and quality control must be solved. It is for the above reasons that the Industrial Research Unit (Singapore) was formed in May 1963, with an initial grant equivalent to $US 120 000 from the New Zealand Government.

Organization

The Industrial Research Unit (IRU) is located within the confines of the Singapore Polytechnic campus, on Prince Edward Road, Singapore. Its close proximity to the Polytechnic ensures that the full resources of that Institution's library, laboratories, workshops and technical personnel may be utilized in support of IRU facilities in solving industrial technological problems. IRU is under the jurisdiction of the Economic Development Board, a quasi-governmental concern in Singapore, which is generally responsible for industrialization.

The functions of IRU include the following:

(*a*) To help in the introduction, development and adaptation of advanced technology to local industries;

(*b*) To undertake the research and development of locally available raw materials with a view to discovering new uses as well as improving current applications;

(*c*) To help in the study of processes first on a laboratory scale and then during the pilot plant stage;

(*d*) To undertake the testing and quality control of raw materials and standardization of finished products;

(*e*) To service and calibrate a wide range of sophisticated optical, mechanical, electrical and electronic industrial instruments;

(*f*) To assist in the development and maintenauce of local standard specifications;

(*g*) To act as a repository of information on the most recent developments in science and technology in various parts of the world.

In order to provide such a comprehensive range of activity, the IRU staff is composed of United Nations and Colombo Plan personnel, a modest group of twelve young local engineers and scientists, and a group of sixteen technicians.

Substantively, IRU is divided into four main sections: (i) Chemical engineering; (ii) Electrical/electronics engineering; (iii) Instrument repair/calibration; and (iv) Mechanical engineering.

Finances

The budget of IRU is mainly derived from funds provided by the Government of Singapore through the Economic Development Board and also partly from the fees paid by industries for services rendered. The total budget figure for the year 1965 is equivalent to $US 1 848 000 and is allocated as follows: Capital, 34 per cent; staff salaries, 31 per cent; and recurring expenses, 35 per cent.

Research and development

During the past three years, a considerable amount of work has been done in the field of testing and standardization, and solving day-to-day technological problems in industries. Since the range of goods locally manufactured is extensive, the variation in types of equipment required for testing their quality is considerable.

It has been the practice of IRU to encourage its staff to design such testing equipment whenever possible, rather than purchase it from foreign concerns. As most of the staff is recruited directly from the universities, the design and construction of this testing equipment provides a creative challenge, as well as excellent training. This can be of future benefit in research work in which staff may be required to design and construct their own research apparatus. Some successful examples of these undertakings are given below.

The construction of a hydraulic 50 000 kg./m^2-capacity testing machine was further developed to include compression testing with provision for strain gauge links for load measurement. This useful project required design, construction and experimentation phases.

Construction of a laboratory scale water treatment plant is now under way. It will provide necessary forms of physical, chemical and bacteriological treatment in actual works; e.g., flocculation, coagulation, sedimentation, filtration, aeration, ion exchange and chlorination. This laboratory scale plant will be used to study all types of raw water, particularly river water and treated sewage effluent. A water treatment plant with a capacity of 10 million gallons per day is already in operation in Singapore; it uses treated sewage effluent to produce industrial water. This laboratory scale plant will be used to study further upgrading of treated industrial water.

The testing of ballasts involves the measurement of voltage, amperage and wattage, as well as impedances and light output of lamps. To facilitate these measurements and also to cope with the large number of ballasts tested, IRU has incorporated the various test circuitry into a comprehensive test panel, thereby increasing the testing facility to twenty-four pieces at a time. Measurement techniques have been reduced to a set of simple instructions so that even a laboratory assistant can conduct the test.

A three-phase, 440 V, 50 c/s motor-alternator set has been installed in the electrical power laboratory. The control panel for the set has been so designed as to allow for easy access to the various electrical components of the motor-alternator circuit. This arrangement will facilitate the operation of the generator either by self-excitation or external excitation. Various metering circuits have been incorporated for measurements of power, power factor, frequency, voltage and current.

An additional control panel has been designed for a 20 h.p. d.c. generator coupled mechanically to a 30 h.p. slip ring induction motor. This permits easy electrical access and external excitation power supplies. The motor generator set coupled electrically to other d.c. motors serves as a versatile speed control unit.

The above motor-alternator, motor d.c. generator and d.c. motors can be used for the testing of contactors, small motors, generators and circuit breakers, in addition to serving as a source of mechanical torque load.

In addition to the design and development of equipment, IRU has devoted considerable time to the study of local raw materials and waste product utilization.

Preliminary investigations conducted on bunch waste, a by-product of the oil palm industry, with a view to recovering its oil content and investigating its use as a raw material for the paper industry, have been encouraging.

A preliminary exploration was undertaken on possible deposits of black plastic clay and kaolin in Singapore. Experiments were conducted on this clay as the basic raw material to be mixed with other ceramic ingredients for the production of wall tiles, mosaic tiles, sanitary wares, stone wares and other ceramic bodies. Although the studies have not been extensive, they confirmed the possibilities of manufacturing such ceramic bodies locally.

Some investigation has been made on the use of hollow blocks. Samples of sawdust, concrete and ordinary concrete have been used for thermal conductivity tests. In addition, moulds are being prepared for making sawdust concrete roofing tiles reinforced with wire netting.

It is interesting to note that the island of Singapore, partly because of its geographical position, is one of the best locales for studying corrosion activity. As such, a survey was conducted on locally made primers for use on metals. The following classes of primers were considered: (i) red lead primers; (ii) zinc chromate primers; (iii) red lead iron oxide primers. Zinc chromate primers proved to be unsuccessful because they have very poor resistance to salt spray and humidity. Linseed oil red primer proved to be the best, except that the drying time is rather long. Experiments further indicated that iron oxide cannot be used in place of red lead.

The possibility of utilizing local raw materials for the manufacture of tourist souvenir articles has also been given attention. In this connexion, IRU manufactured prototypes of ceramic ware from local clay, pendants from mother of pearl, jewellery from sea shells, wood carvings from local timber and castings for pewter.

Figure I. Determining the nitrogenous compounds in water.

Figure II. Testing the scratch resistance of paints.

Figure III. Suppressing radio frequency radiation in a high-frequency welding machine.

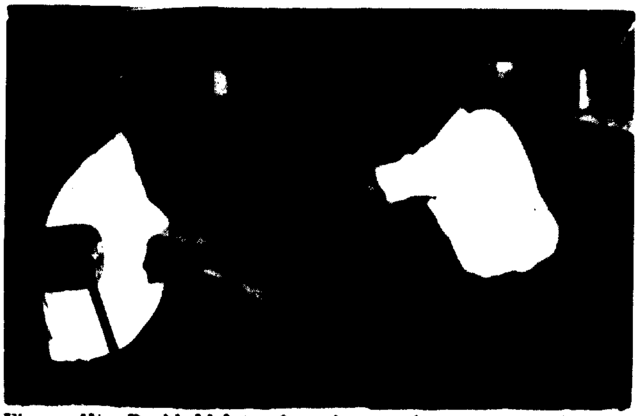

Figure IV. Rapid high-tension electrostatic separator being repaired.

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