

**PURDUE UNIVERSITY**

**International Education and Research  
International Programs in Agriculture**



**PORTUGAL UNIVERSITY  
INSTITUTES  
DEVELOPMENT PROJECT**

**(Contract AID/NE-C-1701)**

**REPORT ON  
SHORT-TERM STAFF ASSIGNMENT  
Instituto Universitario de Trans-os-Montes  
e Alto Douro, Vila Real, Portugal**

**Submitted by  
DR. H. GARTH SPENCER  
Clemson University  
Clemson, South Carolina**

**October 22 - December 22, 1982**

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INSTITUTO UNIVERSITARIO DA BEIRA INTERIOR

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## REPORT OF SHORT-TERM ADVISOR

DR. H. GARTH SPENCER  
Clemson University  
Clemson, South Carolina

### Area of Assignment:

Advisor to Department of Chemistry, Instituto Universitario da Beira Interior, Covilha, Portugal.

### Objectives of Assignment:

The objectives were to assist the Chemistry Department establish research activities and develop an orientation toward polymer chemistry in courses, research, and extension.

The program was divided into three areas of activity:

- a) Teaching and Course Content-- Teach a course on "Physical Chemistry of Polymers" for faculty and students. Discuss the content of the chemistry courses at IUBI with the chemistry faculty.
- b) Research Projects-- Develop new research areas utilizing the human and scientific resources at IUBI and in cooperation with plants that produce synthetic fibers, if possible.

Meet with researchers involved in current research projects, especially those concerned with energy and water conservation and with effluent problems in the textile industry.

- c) Extension-- Participate in a seminar for academic and industrial technical personnel on industrial aqueous effluent problems. Visit textile plants and the Textile Institute in Covilha.

Portuguese Counterparts at IUBI:

Dr. Isabel Ferra, Head of the Department of Chemistry

Dr. Teresa Amorim, faculty member in the Department of Chemistry

Accomplishments with Respect to Objectives:

A. Teaching and Course Content:

A representative course on "Physical Chemistry of Polymers," was taught in 20 lectures. This was a survey course emphasizing practical aspects of the physical chemistry of polymers. Attention was directed to topics of interest to textile chemists and engineers. It was representative of material taught to chemistry and textile students at Clemson University.

Complete notes were prepared, photocopied, and distributed to the class participants. The lectures were in English. Illustrations of principles were provided and the overhead projector was used extensively with prepared transparencies in order to cover as much material as possible in the limited time and to help overcome any language problems. The participants were almost exclusively Chemistry Department faculty members and the average class attendance was four or five.

An outline of the course is attached and copies of the complete notes were provided those attending the lectures.

Informal discussions about the curriculum and the content of the courses were carried out with the senior chemistry faculty members.

B. Research Projects:

A research project on the structural features of polyester fibers determined by infrared spectroscopy, density, and X-ray diffraction methods was initiated with Dr. Teresa Amorim. A preliminary description of the research project has been written and left with Dr. Amorim. The

project involves the use of the infrared spectrophotometer and other equipment at IUBI. Equipment at the Textile Institute in Covilha may also be required. The X-ray diffraction studies will be carried out at Clemson University in a continuing cooperative research effort. Samples of polyester fibers are being obtained by Dr. Amorim from Portuguese and other suppliers.

By studying effects of thermal and chemical exposures on the fiber structure, several areas of research are available for student assistants in the department to develop research projects under the direction of Dr. Amorim within the framework of the polymer structure project.

The current research project on the analysis of influent and plant and unit process effluents occurring in selected textile plants was discussed with Drs. Ferra and Amorim. Some reports on similar studies accomplished by researchers at Clemson University will be sent to those researchers. These reports will provide some examples of the available methods and illustrate the value of such studies.

#### C. Extension:

Visits were made to the Textile Institute in Covilha; Paulo de Oliveira, a wool fabric producer; Penteadora, primarily a wool fabric producer; and Finicisa, a manufacturer and processor of polyester and a producer of polyester and acrylic fabrics. Finicisa is the only producer of polyester in Portugal.

A seminar on "Problemas de Efluentes Líquidos Industriais" was held on December 13, 1982, at IUBI. Six lectures were given, including one I presented. The seminar attracted about 30 participants external to IUBI from throughout Portugal, in addition to 10 participants from IUBI.

D. Acknowledgement:

The personnel at IUBI were most cooperative, and they assumed responsibility and took the initiative for planning my many varied activities so as much as possible could be accomplished during this brief visit. Special thanks are due my Portuguese counterparts and the secretarial staff, and to the others who contributed to the program.

Identification and Analysis of Problems Encountered

(1) Living accommodations for me and my wife and provision for a place to work, both an office and a laboratory, were very good. Scheduling and support for my activities were well planned and carried out with dispatch. No problems occurred in these areas.

(2) A long-term advisor could have been valuable. My contribution might have been enhanced if a long-term advisor had been available to rapidly orient my work in the long-term development plan, point out changes needed in my approach to the assignment, bring me into contact with personnel as needed, and provide follow-up after the visit.

(3) The course was presented primarily to the senior faculty members in chemistry, who attended regularly. These were the proper participants because they will be responsible for any orientation in the courses towards polymer chemistry that results from the visit. I regret the lectures had no more appeal to the textile engineering faculty members, advanced students in that area, and more of the chemistry teaching assistants. There are no advanced chemistry students at IUBI who might have participated in the lectures. Language, conflicting or busy schedules, subject matter and manner of presentation possibly all contributed to reducing attendance by personnel with only a casual interest in polymer chemistry.

### Future Requirements and Proposed Actions

(1) There will be a cooperative continuation of the research effort in polymer structure determination and modification by Dr. Amorim and myself. Most of the research will be accomplished at IUBI. However, an updating of the literature search and X-ray diffraction studies will be carried out at Clemson University. Attempts to obtain external funding for this research could be written cooperatively after we have obtained preliminary data.

(2) It is recommended that chemistry teaching assistants participate in this research effort under the direction of Dr. Amorim. The ability to attract and retain an able faculty upon which greater chemistry activity and influence at IUBI can be developed will depend partially on opportunity for participating in research

There are no advanced or graduate students, or technicians available for research participation. Thus, the chemistry teaching assistants must become involved in a significant way. Perhaps research reports should be required from them each term and their research accomplishments included in their annual performance evaluations.

(3) The equipment necessary for the research effort on polymer structure determination and modification is adequate for initiation of the project. The expected addition of a nuclear magnetic resonance (NMR) spectrometer will make additional research available. Accessories for the infrared spectrophotometer that would improve the quality and expand the scope of the research are:

- (a) a polarizer
- (b) a temperature-controlled cell or fiber mount, and
- (c) a multiple internal reflection spectroscope (MIRS) apparatus.

Acquisition of these accessories should be anticipated in future budgets.

(4) Reports related to analysis of textile plant effluents will be forwarded by me on my return to Clemson. Perhaps these will be useful during the establishment of research in this area. Apparently funds are available for the initiation of the research.

(5) The senior chemistry faculty should review the various curricula and the syllabus of each chemistry course to determine whether material on the physical chemistry of polymers should be included in these courses and how detailed it should be. Further, this faculty should review any changes with the faculty in textile engineering since the advanced students in that area are the ones that would most benefit from inclusion of the material.

(6) The seminar was quite successful and pointed to IUBI as a university institute involved in both teaching and research aspects of a government and industry related concern.

PHYSICAL CHEMISTRY OF POLYMERS

<u>LECTURE</u>	<u>TOPIC</u>
1	Introduction: Molecular Weight
2	Determination of Molecular Weight
3	Determination of Molecular Weight Distribution General Structure-Property Relationships
4	Condensation (step) Polymerization; Kinetics
5	Condensation Polymers and their Properties
6	Radical Vinyl (addition) Polymerization; Kinetics
7	Vinyl Polymers and their Properties; Copolymerization
8	Reactions of Polymers
9	Reaction of Polymers
10	Microstructure
11	Vibrational Spectroscopy
12	Applications of Vibrational Spectroscopy
13	Nuclear Magnetic Resonance (NMR)
14	Applications of NMR
15	Morphology
16	Polymer-Solvent Systems; Thermodynamics
17	Polymer Alloys
18	Diffusion and Permeability of Gases and Vapors in Polymers
19	Water in Polymers
20	History and Research Trends of Polymer Science