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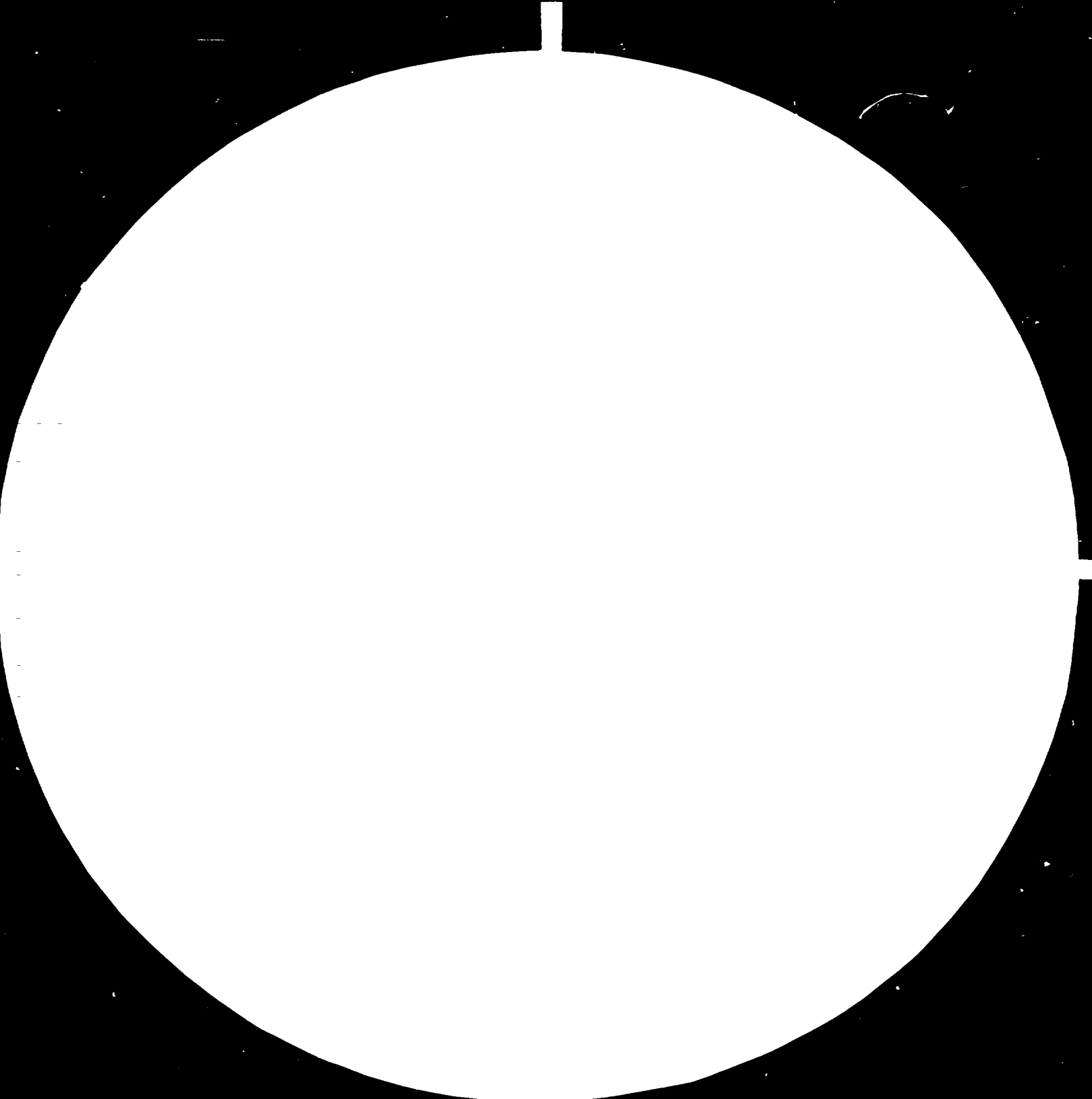

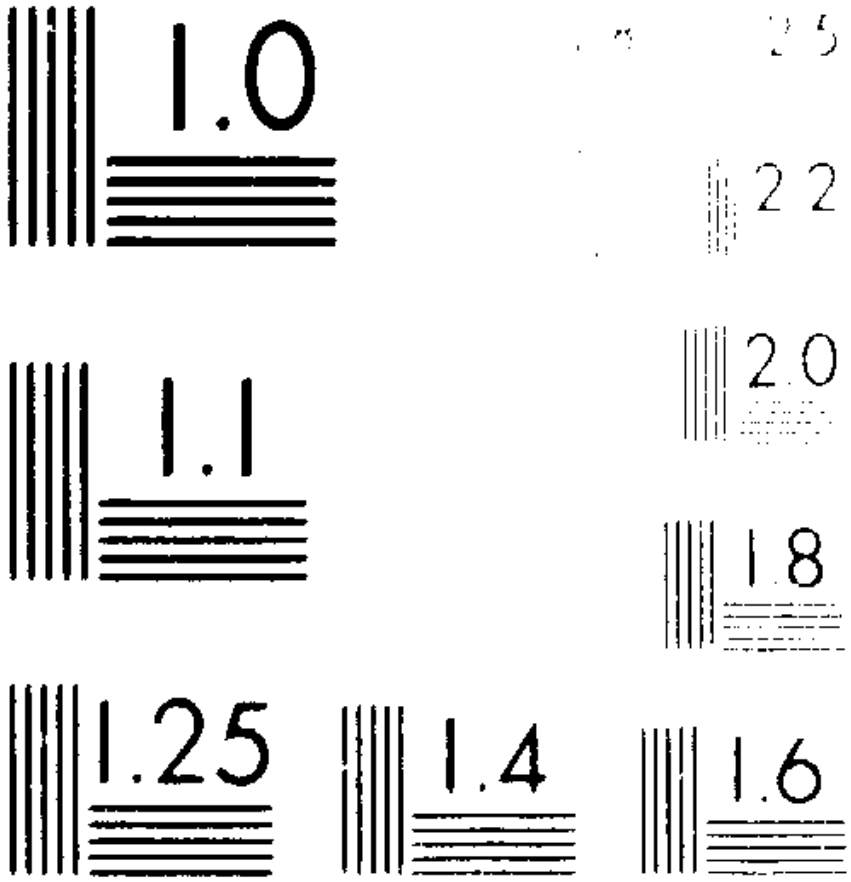
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UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

Pilot plant and laboratory research in optimizing the Patfoort Housing System .

SI/MEX/79/801

000007

Interim report prepared for
The Government of MEXICO

by

Prof. Georges A. Patfoort & Ing. Moniek E. Bucquoye
Experts of the United Nations Industrial Development Organization

After Briefing in Vienna (28 march 1980) , the two experts arrived in Mexico-city on saturday 29 of march. They had an extensive interview with Mr. André FAUST - JPO UNDP office - on the 31 of march , to have a general survey of the situation of the project . In the afternoon the experts took the plane to Monterey , to arrive in the evening in Saltillo .

As Dr. Enrique CAMPOS L. - director of CIQA - explained already in Vienna (visit to UNIDO in february 1980), there was some delay in the financing of the activities of CIQA for 1980. This was due to the administrative transfer of CONAZA,(Nacional Commission for arid areas .) one of the principal financial sources of CIQA , to another ministry and at the same time also a change in the administrative structure and dependency of CIQA . In the second place : there was a coincidence of this difficulties with the moving out of the CIQA laboratories to new buildings and adaptation and finishing works that are involved in the get under way of the new laboratories .

Mr. CAMPOS emphasised and explained largely this problems with the certainty that this problems will soon have a solution and that in the meantime the financial problems that retarded the good functioning of the project , would be solved by giving it absolute priority . The foreseen budget will be respected . It was agreed that Architect Etienne VERHEUGEN - UNIDO construction expert - can reckon from now on , on an administrative counterpart in the project - Ing. Ernesto NEAVEZ - who has to solve current finacial problems and to take the measures for the long term planning of the project . The administrative counterpart organised immediatly a meeting with the financial sectior of CIQA - Mr. ANGEL administrator - . There , it was agreed that expert VERHEUGEN would receive a current credit in several factories and shops in Saltillo and Monterey to acquire materials etc. , so that all administrative complications in the financial management of the project could be eliminated . A car was also immediatly available for the project from monday 7th april on .

Present situation of the project is as follows :
the shed with warehouse is practically ready . Some partitions are made inside to facilitate storage . Since architect Verheugen made in the meantime all necessary drawings, sketches, details of all constructive parts etc. and a team of carpenters is already at work , mould and machine construction can start immediatly .

In the meantime , some alternatives were worked out with architect VERHEUGEN in relation to the adoption of the exterior of the houses to local architecture and especially the possibilities of the fabrication of large semi-rigid membranes for covering large surfaces. A note on this topic is prepared by Mr. Verheugen .
Untill now, the architectural counterpart of the project : architect Sergio MIER , was involved in all drawing discussions and is responsable for mould and machine construction .

Due to the move to the new laboratories , few work has been done on the long term properties of the composites with natural fibre reinforcement . The experts insisted on the urgent need for this data .
On the other side , work already started for the construction of a mat making machine with Ing. RAMIREZ in charge of this part of the project. The expert team had different working sessions on the design of the machine with the complete CIQA team working on the different parts of the project . It is indeed necessary to have at the disposal of the project a minimum quantity of mat to experiment the new composite in practice . To gain time , the machine will be constructed as a pilot device without introducing efficiency and high production conditions .

Discussions with Dr. CAMPOS, lead to the conclusion that some work has to be done in the project related with developments in the scientific and technological field : strenghtening of the laboratory testing , developing mat making on industrial scale and construction of a universal machine to realise high quality mat and extension of the technology to the hennequen fibres , establishing the bases for interchange and dissemina-

tion of the new technology in the form of training and cooperation in research and applications on a global and interregional scale .
A draft project proposal was worked out (see annex). The request of CIQA to CONACYT (National Council for Science and Technology) is joined in annex I & II . This project would function as a link between present work and a future extension of composite applications development in the form of a coordination center for the countries of Latin America , as it was requested by a large number of countries at the TCDC meeting in Guayaquil(Ecuador) in november 1979 .

On Wednesday 9th of april , the experts met Mr. A. FAUST , JPO UNDP Mexico city , It was agreed and confirmed by Dr.E. Campos , that he should meet Mr. JIMENEZ - RR - on the 11th of april , to make the definitive arrangements for the extension of Mr. Verheugen 's mission , in agreement with the arrangement that had been taken with Mr. H.MAY - Head Chemical Section UNIDO Vienna -. (Annex III)
The experts met on the same day Mr. Raoul N. UNDARZA- General Secretary of CONACYT . He was in complete agreement with the future developments of the projects , especially in relation with the international and interregional cooperation . The experts met also mr. GUTIEREZ ARCE (international programs) Mr. WEISSBLOED (transfer of technologies) and Mr Jaimen PARADA in CONACYT . They insisted in the present policy of CONACYT in relation with technological projects . The projects have to be developed on the basis of shared risks with the industry and new projects will only be accepted if there is already interest from the part of the industry to participate in financing the research activities .

The coordinator of the project- prof. G. patfoort - left the country on 10th of april to continue his mission to the People's Republic of China . Ing. Bucquoye left on 11th of april Debriefing was realised in Vienna on the 5th of may .

Programm shedule

27 march 1980	: departure
28 march	briefing at UNIDO - Vienna
29 march	departure MEXICO (arrival same day)
31 march	: briefing at UNDP Mexico
	departure Saltillo (arrival same day)
1 april 1980	: Visit to CIQA direction (Dr. Campos absent)
	Discussion with arch. Verheugen
2 april 1980	: Meeting with Dr. H. Belmares - head polymer research at CIQA _, Ing. Ramirez(responsable for mat making machine), architect Sergio Mier (architectural counterpart) to discuss present situation of the project .
3 april 1980	:Meeting with Ing. Ernesto Neavez and Mr. Angel in order to solve financial and administrative problesm .
4 april 1980	: Discussion on membrane structure with Architect Verheugen .
7 april 1980	: Meeting with Dr.E.Campos to discuss the draft proposal of the new project (see annex)
	Visit to the new laboratories and facilities , workshops and mould construction facilities of the project .
8 april 1980	: Final draft was proposed to Mr.CAMPOS of the new project
	Discussions with Dr. Belmares on further laboratory work , fatique tests etc .
	departure for Mexico city .
9 april 1980	: debriefing at UNDB office with Mr. A. Faust JPO
	Meeting at Conacyt with Mr. R. Undarza, Mr. Parada, Mr. Weissbloed, Mr. Gutierrz .
10 april 1980	: departure of prof. Patfoort
11 april 1980	: departure of ing. Bucquoye
5 may 1980	: Debriefing at UNIDO Vienna .

D R A F T P R O J E C T P R O P O S A L

Country : Mexico
Project n° : ..... /MEX/80
Sheduled start : june 1980
Sheduled completion : decmebr 1981
project title : Applications of natural fibres and local ressource in composite construction systems
Government counterpart : CIQA
CONACYT
UNIDO Contribution : United Nations Interim Fund for Science and Technology for Development
Governm. Contribution : (under discussion)

BACKGROUND

I n f o r m a t i o n

In response to the ECOSOC resolution 1886(LVII)concerning the promotion of low cost housing , based on polymers in combination with locally available materials and the results obtained from realisations in Cyprus, Uruguay, Upper-Volta and Ecuador with the Patfoort construction system , the latest experiments demonstrates that composite materials technology can lead to low cost and low energy construction in housing , roofs , shelters and rural applications as silos, reservoirs, pipes , tunnels etc .

In the scope of a UNIDO project SI/MEX/79/801 in the Research Center for Applied Chemistry in Saltillo - CIQA- (Mexico) in collaboration with the National Council for Science and Technology - CONACYT - and the National Council for arid areas-CONAZA-, a research programme is set up to study the utilisations of natural fibres in the production of fibre reinforced building materials (hereinafter referred to as composite materials) in applications following the patfoort construction system .Some of the applications of these composite are in an adapted filament winding construction method .

II

Natural fibres are produced all over the world . Some of them are extensively used in textile industry and as packaging material , some others as ropes and brushes . A large quantity of fibrous materials is to short and to hard to be spun or woven ans is wasted . The market for natural fibres is also very fluctuating and this causes many problems for the inhabitants of areas living from the fibre industry . Especially in packaging, rope and brush applications , the fibre industry experiences rapidly growing competence from the synthetic fibre development .
To this date , no programme has been made to develop new alternatives for the applications of the fibres and to assist people living from this industry in leading a productive life .

R e a l i s a t i o n

In the first phase - nov.79-april 80 - of the project SI/MEX/79/801 the foreseen objectives were realized . A pilot plant was built . People were trained in laboratory work and the research team realised in a short time the necessary composites on laboratory scale .
In the second phase —may - oct 80 — real construction has to be realized with the developed composites but with a technology that already has been proved to be adequate in previous experiments .

To understand the importance of the already realised work ,it is necessary to survey the results of the research work done at CIQA . Present state of knowledge in the field of composites is as follows : a lot of experimental work has been done in the use of natural fibres in combination with a matrix to obtain composites with similar reinforcing properties as e.g. polyester and glass fibres . Obtained results were generally deceiving for following reasons :

- lack of foreseen reinforcing properties
- over absorption of resin in the fibres
- lack of resistance against bacteria and humidity
- lack of coherence in strengtening properties of fibres

In natural state (non-treated fibres) the specific tensile strenght of many fibres is of the same order of magnitude as glass fibres , when taking into account density and especially when prices are calculated to obtain a given required strenght . Unfortunatly results of composites with natural fibres are not in agreement with the expectations . Severe analysis of tests performed on samples prepared in CIQA laboratories permits to conclude :

- mechanical treatment of fibres is diminishing drastically their strenght performances by deterioration of their structure
- the high tensile strenght of natural fibres can only be saved without spinning, torsioning or weaving them .
- taking into account the discontinuity of natural fibres yarn and having the experience that spinning is not acceptable, the most evident form of natural fibre reinforcement is m a t .

A coating material for fibres was developed to function as a binder for fibres in mat fabrication to assure a good wetting with the resins and a good adhesion with the fibre surface . At the same time, the binder has to assure the function of avoiding excessive resin absorption , to decrease delamination tendencies , to include bacterial and humidity resistance and last but not least to function as a binder to make mat that would be resistant to the treatment in a resin bath .

The coating developed by ciqa , proved to have solved not only impermeabilisation and interphase problems but proved also to be an excellent mat binder , that gives not only a very sufficient consistency and tensile strenght to the mat , but also has the property not to looze strenght properties by wetting the fibres with resin or passing them into an impregnation bath or a filament winding machine that is the basic equipemnt for the construction of large structures and membranes .

The laboratory tests at CIQA demonstrated following properties : a natural fibre reinforcement is available with following propert

- the same order of magnitude of resin absorption as glass
- the same volume of composite material can be obtained with identical strenght for half the price .
- the reinforcement can be used in filament winding processes .
- the reinforcement is to a large extent independent of the fibre nature and permits its general applications with the use of non-weavable fibres and waste fibres of insufficient lenght, that are generally considered as throw away materials .
- the developed technology can evidently be applied to high quali ty fibres as hennequen , jute , palm fibres etc. to obtain high performance materials .

JUSTIFICATION

In response to the resolutions of the General Assembly of the United Nations in its 34th session (second committee aganda item 70) , establishing the United Nations Interim Fund dor Science and Technology for Development " as a response to the recommendations of the United Nations Conference on Science and Technology for Development- UNCSTED- in Vienna august 1979, and considering the results already abtained by the UNIDO projects, it is necessary to develop and to strenghten scientific and technological capacities of the country, to develop the internationa copperation in the field of science and technology for development with developed countries and among developing countries and to promote and support the activities necessary to prepare for future efforts in the field of Science and Technology of natural fibres and to facilitate the international exchange of experiences and information .

AIMS OF THE PROJECT

All over the world, problems in the natural fibre industry and the use of wasted fibres could be solved by using them in composite systems for construction purposes .
In connection with the present results of CIQA it is necessary to develop a programme to assure the dissemination of the innovative developed technology , to strenghten the laboratory testing in view of new and better performances , to develop adequate equipment to go from laboratory scale to pilot plant and industry , to practice and develop adequate composite design methods in construction , to establish the bases for a global and interregional project in the field of composites with natural renewable mat rials , to organise training and co-operation projects in research developments and applications .

V

OBJECTIVES

I. Development of an universal , simple and effective non-woven mat machine .

II. Testing of the long term behaviour of the natural fibre composites in engineering properties .

III. Development of appropriate design methods adapted to natural fibres composites using renewable ressources .

IV. Prepare a team of CIQA laboratory people , to extend the developed methods to applications of fibres from other regions and climates .

V. Strenghten national capacities for the assessement , selection , acquisition and adaptation of foreign technologies .

VI. Assure the dissemination of the developed technologies through international exchange of experiences, information , training facilities and fellowships .

VII. Taking a limited number of risk-involving experiments in the field of structural design using the specific properties of composite sytems .

VIII. An information bank on natural renewable fibres ressources and their applications in composites and composite systems has to be set-up .

I Development of an universal and simple non-woven mat making machine .

In the framework of the going on programme, a limited quantity of mat will be realized for the fabrication of a quantity of structures, sufficient to demonstrate the factibility of the process .
Passing from this pilot method to industrial production necessitates the acquisition of knowledge that will be realised through a study tour of four members of the CIQA team in different European countries where mat-making out of different fibre qualities has been developed . The presence of an expert in this field will be necessary .

II Testing of long term behaviour of natural fibre composites

Because of the necessity of non-traditional testing methods on materials and structures , some equipment has to be built.A weathering equipment or facilities to perform the accelerated weathering experiments is essencial . An expert in testing composites should be most usefull .

III Development of appropriate design methods

Different types of structures have to be constructed to demonstrate and control the behaviour of the materials.Methods have to be developed to optimise the performance and to obtain maximum mechanical properties with a minimum use of material and energy . The acquired experience in structural design in previous UNIDO projects with other fibrous materials with similar reinforcing and composite characteristics will be used as a guide in structural design .

IV Training

In view of the use of various forms of fibrous materials , methods have been developed in different parts of Europe to obtain non-woven fabrics or mats . This methods present similitudes with the use of natural fibres for mat making in its preparation, distribution binding methods et c. The technological

strenghtened by a visit and study tour and close contact with other laboartories and companies involved in the development of such technologies . Fabrication methods have to be adapted to fibres from other regions and climates to assure diffusion of acquired experiences in other parts of the world .

V Strenghten national capacities

Specialists in the different fields of chemistry, mechanical construction , architecture, rural development from abroad , will be trained in CIQA as well at laboratory, pilot and executive level , to develop national capacities in view of assuring training facilities and future technological development among other countries .

VI Dissemination of experiences and results

In the Ecuador seminar (nov 1979) on the applications of composites in construction methods, 14 countries of Latin America requested UNIDO a further development and experiments of the demonstrated methods. A first step in the dissemination of the technology acquired with the patfoort construction system in Ecuador and the important improvements to the composite systems that were developed at CIQA , will be performed through the presence of two persons of each country in a training course organised by CIQA where the winding equipment , mat-making machine facilities, treatment of fibres and composite technology will be demonstrated in view of the future establisment of co-operative arrangements and study centers at regional and interregional level among developing countries .

VII Risk involment

Taking in mind the new engineering and structural properties of composites , a serie of risk involving experiments in the field of structural design have to be performed in view of embodying the results of the acquired laboartory experiences in practical constructive applications.

Experimental methods have to be developed in view of their structural evaluation . Construction aplications in the field of housing and rural development will be emphasised .

VIII Information Bank

Taking into account the recommendations of the seminar on composites organised by UNIDO for Latin American Countries - Guayaqui Ecuador nov 1979 - were an interregional and international exchange of information and experiences was highly recommended on the topic of natural renewable fibres ressources and their applications in composites and composite systems, it seems that the CIQA laboratory with its library and databank is completely prepared to take up this job .

INTERNATIONAL CONTRIBUTION

Construction expert	: 12 months		
material expert(composites)	3 "		
fibre expert	3 "		
testing expert	3 "		
coordinator	3 "		
	24 months	US $	130.000
weathering equipment		US $	35.000
study tour (4 persons 20 days Europe)		US $	17.000
project car & maintenance		US $	13.000
		US $	195.000

NATIONAL CONTRIBUTION

Laboratory facilities, materials, training etc..... ....
under discussion .

ANNEX II

CENTRO DE INVESTIGACION EN QUIMICA APLICADA
ORGANISMO PUBLICO DESCENTRALIZADO
Aldama Ote. 351 Saltillo, Coahuila, México
Tels. 2-67-33, 2-67-35 y 2-67-68

8 de Abril de 1980

Of. CIQA-DG 131/80

LIC. RODULFO FIGUEROA A.
SECRETARIO GENERAL
CONSEJO NACIONAL DE CIENCIA Y TECNOLOGIA
INSURGENTES SUR NO. 1677 - 8o. PISO
MEXICO 20, D. F.

Recientemente hmos tenido la visita del Dr. Patfoort, Coordinador de la UNIDO para el proyecto de Materiales Compuestos Poliéster-Ixtle; después de analizar el estado actual del proyecto, los resultados obtenidos y la gran importancia que se prevee para este proyecto, inclusive a nivel internacional, hemos elaborado el documento que le anexamos, que presenta al CONACYT UNA propuesta preliminar para la ampliación de este proyecto, incorporándolo con una estructura más amplia dentro del fondo que la Organización de las Naciones Unidas, de acuerdo a la última reunión realizada en Viena, ha considerado oportuno canalizar para proyectos de ciencia y tecnología en países en desarrollo.

Creemos que este proyecto reúne los requisitos, puesto que ataca problemas similares en muchos otros países como son:

- Incrementar el esfuerzo en ciencia y tecnología en fuentes renovables de recursos.
- Encontrar salidas tecnológicas a las fibras naturales.
- Integrar materiales locales con polímeros sintéticos en la obtención de materiales alternativos para la construcción.
- Promover la investigación científica y tecnológica en el campo de los materiales.

Mucho le agradeceremos a usted las gestiones que pueda realizar el CONACYT para explorar la posibilidad de que este proyecto sea incluído dentro del nuevo programa de ciencia y tecnología, así como también las sugerencias que usted se sirva hacer para que podamos a la brevedad lograr aclarar cualquier duda al respecto y proporcionar mayor información, si se considera necesario pro-

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ceder a un análisis más detallado del mismo. Aprovecho la presente para agradecerle su valiosa intervención y le reitero a usted la seguridad de mi más atenta y distinguida consideración.

A t e n t a m e n t e,

DR. ENRIQUE CAMPOS LOPEZ
DIRECTOR GENERAL

c.c.- Dr. Edmundo Flores. Director General, CONACYT
c.c.- Lic. Alfredo Ramírez Araiza. Director de Asuntos Internacionales, CONACYT.
c.c.- Dr. Ignacio Gutiérrez Arce. Director Adjunto de Desarrollo Tecnológico, CONACYT.
c.c.- Sr. Danilo Jiménez. Representante Residente del PNUD.
c.c.- Dr. Herbert May. UNIDO, Viena.
c.c.- Prof. Georges Patfoort.
c.c.- Ing. Ernesto Neavez C. Director del Programa de Recursos Renovables, CIQA.

'Anexo (Se indica).
ECL*mbh.

UNITED NATIONS NATIONS UNIES

MEXICO DF 6 PB 6719

Saltillo 7 april 1980
SJ/MEX/79/801 - GP, 24

UNIDO
Dr. H. MAY
Head Chem. Ind. Section
PO Box 300
1400 VIENNA (Austria)

Dear Mister May,

During our briefing in Vienna (28 march 1980), you explained us the administrative problems in relation with the prolongation of Mr. VERHEUGEN'S mission - construction expert - from the first of may untill the end of october 1980.

You confirmed us your agreement with Dr. Enrique CAMPOS L.- Director of CIQA, Saltillo, during his stay in UNIDO headquarters Vienna on the 11th of february, that 3 months prolongation would be paid by UNIDO under the conditions that the other additional months would be covered by the Mexican Authorities.
We have to take in mind, that in case of no-agreement the mission of architect E. VERHEUGEN finished on the first of may 1980. So we have to look for an immediate solution because of the short delay.

Since Dr. Campos cannot accompany us to the PNUD Mexico on 8 april, but made an appointment with Mr. FAUST - JPO PNUD- on the 10th of april, we confirm you the agreement we made and that will be officialised on thursday with Mr. JIMENEZ- RR PNUD-.

On the 3th of march, Dr. CAMPOS wrote a letter to CONACYT (with copy to PNUD & UNIDO) to obtain an intervention in the prolongation of Mr. Verheugen's mission. No answer was received untill now. If there is no change in the position of CONACYT untill thursday, Dr. CAMPOS will sign an agreement with the Resident Representative in MEXICO, to assure the prolongation of Mr. VERHEUGEN - UNIDO expert - for two more months with the own fund of CIQA.

We will inform Mr. A. FAUST on the urgent character of the matter so that immediate action can be taken up and that a telex with the confirmation can reach the Vienna adminstration in time.

Yours Sincerely,

04/04/80

G.A. PATTOOTT
project coordinator

M.E. BUCQUOYE
expert

cc. Dr. Campos CIQA
cc. PR. PNUD Mexico