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PESTICIDE DEVELOPMENT PROGRAMME IN INDIA

DP/IND/80/037

INDIA

Technical report: Findings and recommendations*

Prepared for the Government of India
by the United Nations Industrial Development Organization
acting as executing agency for the United Nations Development Programme

Based on the work of Dr. Wade Van Valkenburg
Expert on pesticide formulations

United Nations Industrial Development Organization
Vienna

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Explanatory Notes :

UNDP (United Nations Development Programme) sponsors (PDPI) (Pesticide Development Programme India) under the aegis of HIL (Hindustan Insecticides Limited) a Government of India Enterprise.

This report covers the period of February 21, 1986 through April 8, 1986 while the writer, Dr. Wade Van Valkenburg, UNIDO expert on pesticide formulations, was assigned to PDPI which has its offices and laboratories at HIL research complex at Gurgaon, a short distance from New Delhi.

It is anticipated that this writer will return to PDPI for his third month of assignment in October of 1986 or February of 1987.

ACKNOWLEDGEMENT

To the responsible parties of UNDP and PDPI I convey my sincere gratitude for the invitation and opportunity to serve PDPI and the Government of India for these past two months. It has been a tremendous learning experience plus having the benefit of making many new friends.

Special thanks go to Dr. S.K. Khetan for the many conversations covering subject matter from PDPI objectives and goals to explanations of Indian customs and procedures.

Others to whom I express my sincere thanks include Dr. M.K. Hussein and Mr. Sat Pal of UNDP, Dr. S.P. Dhua and Mr. M. Lal of HIL and all the staff of PDPI.

Many others made this tour of duty a rewarding experience. These include the NOCIL, Lote and Bombay, management and staff, the management and staff of Frederick Research Institute, the staff and administration of the A.C.College of Technology, Madras and the personnel from BASF, Delhi and Bombay. My sincere words of thanks are extended to all.

Finally I extend my appreciation to Dr. C.E.Price, UNIDO consultant for our many hours of thoughtful conversation and deliberations.

Summary of Conclusions and Recommendations

Conclusions

1. PDPI, through the able leadership of Dr. Khetan has built a small, effective, Centre of excellence for development of pesticide formulation technology in India.
2. PDPI is rapidly becoming recognised by academic and industrial concerns in India as a focal point for pesticide formulations expertise. In this phase of PDPI's career they have accomplished this recognition through the personal efforts of Dr. Khetan and the well attended and well appreciated pesticide formulations training courses.
3. PDPI is continuing to build the level of its technical expertise through visitation of consultants and through procurement of additional training of its staff at offshore cooperative academic and industrial research facilities as well as by attendance at appropriate seminars and conferences.
4. PDPI has heretofore served the pesticide industry primarily by means of formulation training courses and the development of formulations for HIL. They are now expanding their services by means of contractual R&D service for organisations other than HIL.
5. The development of indigenous raw materials in India is being encouraged by the evaluation of regional deposits of clays that may serve as pesticide diluents. Encouragement of new Indian surfactants and emulsifiers is not being done as there now is an abundance of Indian suppliers of these materials. Instead of this PDPI is serving the industry by characterising the available materials.
6. PDPI is inhibited by the bureaucratic approval process under which it now must operate. This consultant will not make a recommendation as to a means of resolving this problem but merely is calling attention to the problem.

Recommendations

1. Personnel : A project such as PDPI should not be overwhelmed by having too many people too early. But it must have a plan for controlled expansion in the number of its staff. Under no circumstances should there be any reduction

in the number of personnel. Right now its size is at a critical mass such that any reduction in head count could seriously undermine the programme's progress.

Plans for expansion of personnel should involve, first, an addition of a senior scientist with a Ph.D in Colloid and Surface Chemistry to DR. Ramdas's staff. There are two reasons for concentrating on this position first. Pesticide formulation technology is high technology. Advances in this technology depend upon a thorough knowledge of colloid and surface chemistry and the application of this science to the industry (see the appendix for the lecture on this subject). In addition, laboratory performance in formulation research is dependent upon one senior scientist in Dr. Ramdas and this is the primary function of PDPI. Should Dr. Ramdas be absent from PDPI for any length of time the performance and viability of PDPI is sharply curtailed. This function must be expanded.

It is also recommended that a five year plan be formulated for personnel growth of PDPI. Growth should involve the acquisition of analytical and biological evaluation personnel. I would give priority, after expansion of Dr. Ramdas's staff to analytical personnel. In the interim, as far as biological evaluation personnel are concerned. I recommend that services in this area be purchased. Pesticide formulation research can not be construed as purely chemistry. The proof in one's work totally relies on whether or not the formulated toxicant control the plant or insect one desires to eradicate.

2. Budget : Currently PDPI has no budget in Indian currency. A programme, such as PDPI, can not be managed effectively unless the management of the project has a close approximation of the resources that will be available to it. There should be a five year forecast of budget with firm commitments to a budget one year in advance. Included in this budget should be a liberal allotment for travel (see below).

3. Membership Programme : PDPI has under consideration the formation of an association of groups and individuals interested in pesticide formulations. Such an organisation would be involved in the dissemination and exchange of information as well as a forum for the establishment of positions on pertinent issues.

PDPI being under the aegis of the government of India, is in an excellent position to sponsor such an organisation. There are a multiplicity of benefits

that could accrue to PDPI but the most important benefits are that such an association will allow PDPI to keep a timely and viable finger on the pulse of the industry and secondly it offers a tremendous opportunity for revenue, which in the long run could assist PDPI in becoming self supporting.

This consultant urges the implementation of the formation of such an organisation, the enrolment of members and the operation of it under the guidance of PDPI. A rough draft document of potential articles of organisation for such an association is included in the appendix for the consideration of PDPI, HIL and UNIDO.

4. Quarterly Publication : A quarterly publication under the sponsorship of PDPI has two valuable benefits. First it forces PDPI to keep abreast of developments in the industry and secondly performs an additional service to the pesticide industry in India. For details regarding the potential contents, please see the appendix.

PDPI should not attempt to publish such a journal by themselves as the mechanics of such an endeavour would overwhelm the staff. Instead PDPI should consider collecting the information, writing copy and turning the information over to an established journal for publication as a special quarterly supplement.

5. Interactions with the industry : In the American musical "The Music Man" there occurs the phrase in a song about a salesman "you've got to know the territory!". Service to the pesticide formulation industry can not be accomplished through training courses and maintaining a centre of excellence. PDPI must travel from the office and interact with participants in the industry to learn their problems and learn wherein and how PDPI can be of service in developing this industry in India. This will require a substantial travel budget to enable PDPI staff members to visit multinationals, nationals, formulation houses and raw material vendors all over the country. Consideration should be given to allotting 2 to 5 lakh rupees a year for this kind of travel and the expenses associated therewith.

As these interactions increase PDPI should set a target of 75% of their research as contract research for people in the industry and academic circles who need their assistance. The remaining 25% should be allocated to pioneering research (microemulsions etc.) and support to HIL.

6. Consultant : There is a very great possibility that PDPI will receive a contract from A.C.College of Technology, Madras, for formulation research on an extract from "bacillus sphaericus". PDPI and UNDP should consider bringing in Dr. Gustave Kohn, Zoecon, Palo Alto, California. Dr. Kohn (Bob to friends) previously was a six month pesticide manufacturing UNDP consultant to India (about ten years ago). Bob is now in the research department of Zoecon, a Company committed to the formulation of microbial agents. He is approximately seventy years old, has the vitality of a 20 year old and is extremely knowledgeable on all facts of pesticide formulations.

Activities

1. Lectures

a) Quality : A Route to Survival : This was the key note address at "Pesticide Formulations", a two day residential concept programme for senior executives. The essence of the talk was the growth of the pesticide business in India through the year 2000 and the fact that there will be many new users of pesticides that are manufactured by upwards of 700 formulators in India. Such a situation calls for every attempt to produce high quality products that will meet every expectation of the customers. Quality products can only be achieved if the industry imposes upon itself high levels of standards that are more rigorous than the ISI standards to which all manufacturers must conform

b) Applied Colloid and Surface Chemistry - Pesticide Formulation Technology.

This lecture was addressed to advanced students in colloid and surface chemistry and scientists involved in pesticide formulation research. The objective of the talk was to point out the many colloid and surface chemical principles that may be applied to the many facets of pesticide formulations research. It was an appeal for students in colloid and surface chemistry to consider a career in pesticide formulation research and for those already in the field to learn and apply more colloid and surface chemistry to their chosen field of endeavour.

c) Adjuvants for Pesticides

This lecture was joint with fellow consultant Dr. E.C.Price. My portion was purely introductory to the subject while the meat of the subject was in

Dr. Price's portion. Therefore, a copy of my portion of the presentation is not included here.

b) **Emulsion Technology**

This lecture reviewed some of the physical chemical principles used in the selection of the most desirable solvents and emulsifiers for emulsifiable concentrates. This then was used as an introduction to microemulsion technology and the possible role of this type of system in pesticidal formulations.

e) **Interactions of Polar Molecules**

The Hard-Soft acid-base theory was introduced with a brief discussion of how this theory would aid in the interpretation of current literature on microemulsions. Then the theory was expanded to show how it may be applied to the dispersion of solids in organic liquids. This technology might be particularly applicable to the dispersion (flowable type formulation) of microbial mosquito larvicides in a spreadable oil. No one has as yet developed such a formulation.

f) **Structure Modification Membrane Technology and Translocation as it Relates to Pesticides**

This lecture was again joint with Dr. Price. The first half contributed by this author is found in the appendix. The pesticide formulator has a great deal more flexibility in designing his formulation when he not only adds inerts to a formulation but modifies the toxicant structure to optimise biological activity and obtain desired physical properties.

2. **Visits to other organisations**

a) **NOCIL, LOTE, India**

This pesticide manufacturing facility is located in a remote rural area. 260 km. south of Bombay. The organisation has an exceptional safety programme and safety training which they are willing to share with PDPI. Their most serious formulation problem stems from variation in the composition of a singly labeled emulsifier. They encourage PDPI to initiate a programme that would set standards for emulsifiers.

b) A.C.College of Technology, Madras

Dr. Khetan, Price and myself delivered a two hour seminar on pesticide formulations research to faculty and students. My portion emphasised colloid and surface chemical principles and how they apply to pesticide formulations research.

Prof. K. Jayaraman invited us to a "Skull session" with her and her students on "bacillus Sphaericus" after which we were privileged to be received by the Vice Chancellor in his office.

c) Frederick Research Institute near Madras

Messrs. Dutta, Khetan, Price and myself participated in a seminar on "Current Thoughts and Future Trends in Pesticide Formulations". The seminar was an overwhelming success with upwards of 150 in attendance. Many positive interactions were made between attendees and PDPI.

My lecture focused on the need to establish standards on raw materials (solvents and emulsifiers) used in the pesticide industry. These materials are too inconsistent in composition and the pesticide industry should request that vendors meet as high a standard for raw materials for the pesticide industry as they do for the textile business.

3. Legal activities

a) BASF with the support of their parent organisation have agreed in principle to place a 20,000 rupees research and development contract with PDPI for formulation work on 'Baselin'[®] herbicide. The first draft of a proposed contract is appended. The contract route is being utilised because this offers all parties an opportunity to agree to the terms and objectives of the project and to be committed to it.

This interaction with BASF is very significant for PDPI because it represents the first service for a member of the pesticide industry outside of HIL.

b) A.C.College of Technology

Prof. K. Jayaraman is one of the leaders in the development of extracts

of "bacillus sphaericus" for the control of mosquito larvae. After considerable discussions with PDPI and preliminary studies Prof. Jayaraman and A.C. College (Biotechnology Board) have agreed in Principle to place a formulation contract with PDPI. A preliminary draft of a proposed contract may be found in the appendix.

c) Dr. Khandal has developed a programme for the evaluation of local clay materials for potential commercial uses. PDPI considers that the state governments of India might be interested in this area. No contracts have been written but initial plans are being made to invite state governments to contract for this kind of service from PDPI.

d) Association of Pesticide Formulators

A draft article of association is submitted as a starting point for consideration and recommendation for improvement.

In all the above legal matters this consultant has acted only as a legal advisory consultant. I have initiated none of the above but have merely attempted to put in writing a document that supports the objectives of PDPI. PDPI is to be commended for these moves which constitute an initial step towards some degree of self support for the day that PDPI is no longer a UNIDO supported project.

4. Miscellaneous

Accompanying the above activities have been many technical discussions in the laboratories. There is no need to elaborate on these as they would only tend to support the high level of technical expertise of the staff of PDPI - a fact which is now recognised by all who come in contact with PDPI.

Conclusion

PDPI has made remarkable progress in the year of its active existence. Continued growth should be nurtured and allowed to proceed on a thoughtfully constructed five year plan.

ABSTRACT

Post : DP/Ind/80/037/11-62/32.1.6

Title : Consultant in Pesticide Formulation

Objective : Advise and assist PDPI on the development of pesticide formulations.

Period : 21-2-86 - 8-4-1986

Conclusions and Recommendations

PDPI has now completed its first phase of growth wherein they have established a centre of excellence and a good reputation in the pesticide formulation industry in India. They should now embark on a planned programme for growth and self sufficiency. Plans should include the hiring of a colloid and surface chemist in the near future, establishment of a rupee budget including a substantial travel budget to interact with others in the industry in India. Emphasis should continue on the development of contractual research with other organisations in India and serious consideration should be given to the formation of an association of pesticide formulators.

**Chairman & Managing Director
Hindustan Insecticides Limited**
requests the pleasure of your company
on the Inauguration of the Concept Programme on
PESTICIDE FORMULATIONS
organised by
Pesticide Development Programme India
a UNDP/UNIDO assisted programme
being implemented by HIL
at 9.30 am on Monday, March 3, 1986

Venue:

**India International Centre,
Lodi Estate, New Delhi**

Programme overleaf

PROGRAMME FOR INAUGURAL SESSION

3rd March 1986

- 9.25 am** Arrival of the Chief Guest
- 9.30 am** Welcome Address by Dr. S.P. Dhuva, CMD, HIL
- 9.40 am** Inaugural Address by Mr. D.V. Kapur, Secretary,
Dept. of Chemicals & Petrochemicals, Ministry
of Industry.
- 10.00 am** Key note address by Dr. J.W. Van Valkenburg,
3 M Company, St. Paul, Minnesota, USA.
- * Vote of Thanks by Mr. Munni Lal, GM(P), HIL

To : Dr. S.K. Khetan

From : Dr. Wade Van Valkenburg

Subject : Trip Report - NOCIL, Bombay and Lote

Date : 24 March 1986

Visited : National Organic Chemical Industries Ltd., Petrochemical Complex at Thane and Agricultural Chemical Complex at Lote

Personnel : Michael Lux; V.P. Works.

S.G.Krishnan; Mgr. Process Technology(Agro Chemicals)

P. Sethi; Agrochemical Site Manager, Lote

V.K.Behl; Operations Mgr., Lote

Dr. V.S.Ranade, Qual. Control Officer, Lote.

Action : (1) NOCIL has a safety programme at their Lote plant which is exceptional and an example to all pesticide industry in India. The architect of this programme and an overall educational programme for users and small formulators is Mr. S.G.Krishnan. Mr. Krishnan would be more than willing to cooperate with PDPI in a pesticide industry safety education programme.

(2) The most serious NOCIL problem is caused by variation in the composition of the purchased emulsifiers from 2 vendors. The variation is serious even from a single vendor. NOCIL encourages PDPI to establish emulsifier standards for pesticide formulations.

Introduction

The visit had great possibilities of becoming a disaster, but fortunately, resulted in a visit that was profitable to visitor and visitee alike.

Upon arrival in Bombay at 8.30 am on 20-3-1986, I tried for over an hour to contact NOCIL by telephone. Attempts at resident and office phones were unsuccessful at 10.00 am. I was able to contact the local office who contacted Thane. At 11.00 am I was picked up by a vehicle from Thane.

NOCIL, initially, was very embarrassed by my presence. There had been no response to their invitation to me and consequently they had made no arrangements for my visit. All the agricultural marketing and sales personnel were out of town and the key R&D and manufacturing personnel were at Lote, 260 kilometers away.

Mr. Krishnan saved the day with a suggestion that he and I travel to Lote and that talks and consulting all be done there. Arrangements were made and we left at about 4 pm arriving at 9.00 pm and stayed until Saturday morning when we drove back. Mr. Krishnan did this with considerable sacrifice as he cancelled both business and personal commitments for Thursday and Friday. As it turned out it was better to go to Lote than to have spent the entire time at Thane. Also because of the change in venue I was not able to visit the Packaging Institute.

NOCIL : 1984 sales for NOCIL amounted to 217,75.25 lakh rupees with 14,35.00 in agricultural chemicals. Petrochemical products include polyethylene, ethylene oxide, PVC, etc., Their ethylene oxide is sold in the Bombay area to 25 separate manufacturers of ethoxylated surfactants. Their agricultural products include monocrotophos and cypermethrin.

The company has a large petrochemical complex at Thane. Process Development for agrochemicals is also done there. Production of agrochemicals is at Lote which is 260 kilometers south.

The company is owned 22% by Shell of Holland but otherwise would be considered a private sector Indian company.

The Lote site must be one of the most beautiful areas of India. It is remote, rural, on top of a hill overlooking a river valley. The air is clean and breezy as it comes in from the sea some 15 kilometers away. Since the site is so remote and communications by phone so poor, plus limited educational and social activities the resident staff are all young, talented, educated engineers and chemists. When a staff member's children get up to the age of 9 or 10, that person will more than likely to be transferred back to Thane.

The company has both a manufacturing and a residential area. Both are beautifully landscaped and equiped with excellent first class facilities. The residential site has been planted heavily with mango and cashew trees which are just beginning to mature.

Safety : The American Chemical Society sent an editor from their Chemical and Engineering news to India to write an article on pesticide manufacture. The Government of India recommended that the editor visit NOCIL at Lote as an example of one of the best plants in India for safety. My observations are also that Lote is excellent in their safety programme and could well be an example for the rest of India.

The man responsible for this programme is Mr. S.G.Krishnan of Thane. He has not only implemented an excellent safety programme for workers but has a brochure and slide programme (I believe in eight dialects) for users and small formulators. He would be more than willing to talk with PDPI and to share his information with PDPI if PDPI were to initiate a programme for safety for those involved in the pesticide business. He anticipated being in Delhi in May.

Technical Problems : About twenty people assembled for my technical presentation and discussion that lasted about three hours. Another two hours were spent in the afternoon discussing specific technical formulation problems.

Most of their formulation problems are related to emulsifiers.

Certain batches of their cypermethrin have gone off colour (5 out of 50). We observed that those lots where off-color occurred all used an emulsifier that used a different solvent (by smell) than the emulsifier which did not cause a problem. It was speculated that this different solvent may be attacking the aluminium cans wherein the resultant aluminium may be catalysing the decomposition of the cypermethrin. They will investigate this more fully.

The most serious problems stem from the variation in emulsifiers. Two emulsifiers from different lots had pH's from 6.5 to 7.5, moisture from 0.1 to 0.2% and higher, a viscosity range from 200 to 500 cps., and so on. This viscosity variation

is particularly serious. As is well known an ethoxylated nonionic surfactant has a wide distribution of molecular weights. For example, one that is specified as containing 10 moles of ethylene oxide may have 5% with one mole and 5% with 40 moles. The very high viscosity is an indication that the molecular weight distribution is skewed towards a preponderance of high molecular weight materials.

This variability in composition can affect the overall HLB of the emulsifier mixture. Therefore a blend of anionic and nonionic emulsifiers would have to be adjusted for each batch of emulsifier used.

NOCIL has been plagued with a gradual change in the emulsifier from their supplier. Some twenty batches ago their surfactant blend was 60 parts of one emulsifier to 20 parts of the other emulsifier. In the course of 20 batches the blend has gradually changed until it presently is 40 parts of one and 40 parts of the other. NOCIL is confident that the emulsifier is the only variable that is changing. Upon review of their data I would concur with their conclusions.

NOCIL does not feel that they have the know-how or position to establish a proper list of specifications for their emulsifiers. They feel that PDPI, by virtue of their position with the Government and with their level of expertise, is in a better position to do this and NOCIL would cooperate extensively with PDPI in such an endeavour. Such a study should probably coordinate molecular weight distribution studies by gel permeation chromatography and performance studies. The effect of pH, moisture, cloud point, phase inversion temperature etc should also be investigated.

Other Areas of Concern

Government : Registration - other countries have cleared a combination of monochlorophos and cypermethrin. India has not. NOCIL can not understand why India prevents the commercialisation of this product found safe in other countries.

Small formulators put out products with poor quality and poor performance. They cannot understand why there are not better controls on performance of these people. The industry can not tolerate a poor image.

There is no control over the user. There is no telling whether or not the user is doing a good job of application, whether the pesticide all drifted away or was poured on the ground or applied only to the top side of plants etc.

NOCIL has no complaint on the following, but, long negotiating could lead to frustrations. Currently they are negotiating with Mobil of the USA for licenses to manufacture trimethyl phosphine. The total package is worth about US \$ 6 million. Of course the whole must be ratified by the Prime Minister.

NOCIL does have some concern about transportation accidents and the proper treatment thereof in case of a hazardous chemical spill. In the 500 km journey I personally saw the results of 10 truck accidents, one a tank truck carrying acid. The driver was obviously incapacitated by the accident and the tank was leaking acid.

Conclusion

NOCIL and its employees are top notch and set high standards for India for all aspects of their business. It was indeed a great privilege to have had an opportunity to have visited them and to have these discussions with them. I sincerely hope that PDPI will have the opportunity to interact with NOCIL in the future.

R&D CONTRACT

This R&D Contract is between the A.C. College of Technology, Guidy, Madras, hereinafter referred to as the 'College' and Pesticide Development Programme India, Gurgaon, hereinafter referred to as "PDPI".

College is currently doing research on an extract of "bacillus sphaericus" a microbial agent used for the control of mosquito larvae. College desires a biologically active, stable formulation of their larvicide, said formulation to have the correct physical properties for ease of dissemination and persistence of activity.

PDPI has amongst its staff personnel and expertise in pesticide formulations. This capability is derived from the procurement of advanced degrees, industrial experience and training by internationally recognised experts in pesticide formulations.

College, through execution of this contract, requests PDPI to devote its time and resources to the development of a "bacillus sphaericus" derivative formulation and PDPI agrees to do so for a period of six months from the effective date of this contract.

For services rendered by PDPI, College agrees to pay the sum of Rs.1,00,000/- said payment to be made in two instalments; Rs.50,000/- to be paid within thirty days of the close of the first three months of this project and the second Rs.50,000/- to be paid within thirty days of the completion of this six month contract.

College agrees to promptly supply PDPI reasonable amounts of the biologically active material on a timely basis. College will supply PDPI assay as well as all appropriate technical information on each lot of sample supplied to PDPI.

Reports of the progress of PDPI on this project will be given to College on a monthly basis. Monthly progress reports shall be posted to College by the fifteenth day after the close of a month. Final complete report must be posted to College by the thirtieth day following the end of this six month project.

It is agreed by both parties that this project is of international interest and will involve the discovery of new principles and relationships. Therefore, this project will be established in two phases, a feasibility phase (three months) and a development phase (three months). During the feasibility phase where new relationships are being established, monthly reports will be summary in nature and need not give complete details. During the development phase, detailed reports by PDPI will be given to College.

Although this contract is for a period of six months, it is renewable for a second six months period. The extended contract may have terms that are modification of this contract, said terms to be in writing and agreed to by both the parties.

Both parties agree to keep the results of this project on a confidential basis until, by a consensus of the signors of this contract, the parties agree to release the results to a third party.

Confidential information may have to be exchanged between College and PDPI in order for the parties to perform the project in a diligent and expeditious manner. By confidential is meant :

- (1) any information known only by College or PDPI and not disclosed to a third party.
- (2) any information which is not in the public domain.

College and PDPI agree to keep confidential any properties information exchanged in this project for a period of two years from the date of execution of this contract or until:

- (1) When in the normal course of events the information becomes known to a third party, or
- (2) When a third party requests either party to maintain the identical information on a confidential basis, or
- (3) When either party discloses that the information is available to the public in a publication or
- (4) When the information is independently discovered by the other party.

In the event this project results in technology, that the parties agree is patentable, filing and prosecution of a patent application will duly be initiated with the expenses thereof to be borne equally by the two parties.

If a patent issues it should issue in the name of PDPI with College having the right to a royalty free license without the right to sublicense.

In the event only one party wishes to file and prosecute a patent he may do so at his own expense. In this case the other party is not eligible for a royalty free license but must cooperate in providing information for the patent application.

College will have the first right to publish the results of this research and may do so, at their discretion, with or without the coauthorship of a member of PDPI within a period of six months following the close of this contract. After the said period, either party may publish at will. In the first six months period College must inform PDPI of their submission of a manuscript to a publisher and provide PDPI with a copy of the manuscript. Once a manuscript is submitted by College to a publisher, PDPI is free to publish and to disseminate the results of this research to any third party.

In the event a patent application is to be made, both parties agree to refrain from informing any third parties of the results of this research prior to the filing of the application with the proper authorities.

The parties agree that this contract contains all the terms of an R&D contract on this project. This contract superceeds any previous writings or discussions of the subject matter and contains all terms agreed to by the parties.

this contract can be modified only in writing and by mutual agreement between the parties.

Signed and sealed:

Prof. Kunthala Jairaman
A.C.College of Technology,
Guindy, Madras

Date:

Dr. Sushil K. Khetan
R&D Manager (PDPI)
for and on behalf of CMD HIL

Date :

R&D CONTRACT

This R&D Contract is between Badische Aniline and Soda Fabrik of Bombay, hereinafter referred to as "BASF" and Pesticide Development Programme India of Gurgaon, hereinafter referred to as 'PDPI'

BASF manufactures and distributes a preemergent herbicide called "Basalin". Basalin must be watered into the soil, but if exposed to ultraviolet light will decompose to form nitrosobenzenes. Basalin is also volatile.

BASF desires to develop a granular basalin formulation which can remain in soil, under ambient conditions of high temperature and low humidity, without degradation, for a period of 4-6 weeks, and thereafter be released from the granule to the soil by the presence of moisture.

PDPI has amongst its staff personnel and expertise in pesticide formulations. This capability is derived from the procurement of advanced degrees, attendance at seminars industrial experience and from the training given to the staff by international experts in pesticide formulations.

PDPI is willing to develop a basalin formulation to BASF specifications. To do this PDPI will compound several candidate formulations in the laboratories and will determine their conformance to BASF specifications in the analytical laboratory and the greenhouse. Information on and samples of formulations that meet BASF formulations will be forwarded to BASF. It is anticipated that this work on the part of PDPI will take six weeks from the date that reasonable samples of Basalin are received from BASF.

For services rendered by PDPI to BASF, BASF agrees to pay Rs.20,000/- within 30 days of the receipt of evaluation samples of candidate formulations.

BASF agrees to promptly supply PDPI reasonable quantities of basalin and any information in BASF's possession that will assist PDPI in the performance of this project.

BASF will label any confidential information passed on to PDPI as BASF confidential. PDPI in turn, agrees to maintain such information on a confidential basis for a period of two years from the initiation of this project or until:

- (a) PDPI is aware that such information is publically available or
- (b) PDPI independently discovers the same information, or
- (c) PDPI is requested by a third party to keep the same information confidential.

In the event this project results in the discovery of technology that is deemed to be patentable, PDPI will file and prosecute a patent application. The costs of such activities will be equally divided amongst the parties. In the event a patent issues the patent will be assigned to PDPI who upon request, will grant a royalty free licence to BASF.

PDPI will make a full report of its work and findings in this project, said report should be delivered to BASF within 45 days after BASF has received evaluation samples of the formulations.

PDPI and BASF agree that the information generated in this project will be kept confidential for a period of two years unless BASF gives written permission for release of the information to a third party.

This written contract contains all the terms of this agreement and superceeds all previous agreements either oral or implied. It may be modified only in writing and with the consent of both parties.

(Dr.S.K. Khetan)
R&D Manager (PDPI)
for & on behalf of
Dr. S.P.Dhua, CMD HIL.

Name, and designation of BASF
Representative

ARTICLES OF AGREEMENT

A I P F

1. **Name of the organization:** Association of Indian Pesticide Formulators.
2. **Purpose:** To exchange and disseminate information of and about pesticide formulations, to offer technical assistance to the industry and to offer a forum for issues confronting the pesticide formulations industry of India.
3. **Members:** Any individual, corporation, or organization involved in the manufacture, marketing, research and development, regulations or professional advancement of pesticides and/or pesticide formulations.
4. **Fees:**
 - Organization: Per voting member: Fees based on sales or budget; fees on sliding scale from 3,000 to 10,000 rupees per voting member; limit, three per organization.
 - Individual: Fee, 3000 rupees.
5. **Officers:** The organization shall have a board of directors of three and officers consisting of an executive director, a financial secretary, and a recording secretary.
6. **Meetings:** There shall be at least one meeting per year which may be held in conjunction with a meeting of the Pesticide Development Programme India.
7. **Membership Entitlements:**
 - a) Free attendance at one PDFF training programme.
 - b) Additional attendees (up to four additional) at 65% of the published registration fee (non-member = 4,000 rupees).
 - c) One free subscription to a quarterly journal on pesticide formulations.
 - d) Up to 10 hours free consulting time.
 - e) Contract research at PDPI at a rate equivalent to 75% of PDPI's published rates.
 - f) Royalty free license on any pesticide formulation patents developed by PDPI on a non-confidential basis.

BY LAWS SHALL CONTAIN BUT NOT BE LIMITED
TO THE FOLLOWING

Duties of the Board of Directors and Officers

Manner of election
Term of office
Manner of removal from office
Duties

Membership Voting Rights

Annual Meeting

Board of Directors Meetings

THE QUARTERLY JOURNAL

Arranged as a separate quarterly edition of an existing journal, such
as "PESTICIDES".

The journal should contain the following:

Conference schedule
Letters to the editor
Short technical papers
News of activities of pesticide formulation companies.
Registration Information
 New registrations
 Registration filings
 Other registration actions
 Backlog information
Pesticide patents issued
ISI Standards