

***POLYMER SCIENCES AND
ENGINEERING
Research at NCL***

Overview

- Mission
- Philosophy of research
- Business interactions
- Competencies
- Research areas
- Output
- Clients
- Summing up

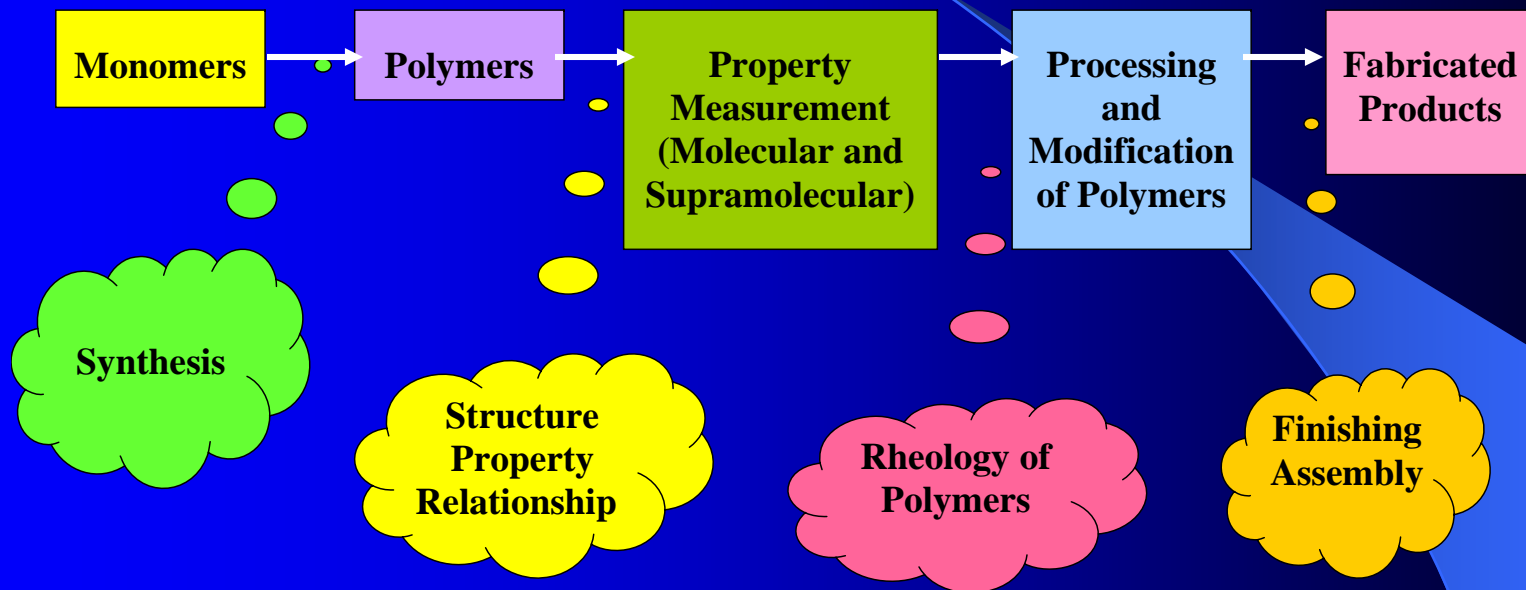
Mission

Strive to be a world class research group in the field of polymers by undertaking research in contemporary areas

Provide value to customers through innovations, development and commercialization of technologies relevant to polymers

Provide value to customers through knowledge based solutions in the area of polymers

COMPETENCIES



- * **50 Scientific Personnel (35 Ph.D.'s) in Chemistry, Physics and Chemical Engineering**
- * **40 Graduate Students**
- * **Largest integrated-interdisciplinary research group for polymer science in India**

Polymer Science and Engineering

Chemistry

Controlled Polymer Synthesis

Metal Catalyzed Polymerization

Polycondensation

Degradable Polymers

Nanoparticles/
Nanocomposites

Water Soluble Polymers

Monomers & polymers from renewable resources

Analytical Characterization

Solution properties (GPC, SEC/LS)

XRD/SAXS/Thermal Properties/ Dynamic Mech Properties/ Microscopy

Spectroscopy

NMR

Sequence, 2D, Pulse Techniques, Solid State

FTIR

GC-Mas; MALDI TOF

Physics

Structure-Property-Processing Relationship

Electrical / Electronic Properties

Crystallization and Morphology

Computational Modeling

QSPR

Conformational Analysis

Simulation of Single Chains

Polymer Science and Engineering

Chemistry

Mesoporous polymers

Polymers for membranes

Encapsulation

Complex Fluids and Polymer Engg

Rheology

Structure Development during Processing

Structure Processing Property Performance Linkages

Modelling and Simulation of Complex Flows

Centre for excellence in scattering

Processing and Testing

Reactive Processing

Property Measurements

Membrane casting

Research Areas

- Controlled polymerization reactions
- Olefin polymerizations
- Polycondensation reactions
- Biodegradable polymers
- Supramolecular polymer systems
- Smart polymers : synthesis and applications
- Conducting polymers
- Polymer nanocomposites

Research Areas

- Polymers for NLO applications / matrices for immobilization
- Carbohydrate polymers
- Rheology of complex fluids
- Crystallization of polymers
- Membrane separations

Facilities

- Contemporary polymer characterization facilities at molecular, mesoscopic and macroscopic length scales
- Thermal, spectroscopy, chromatography, diffraction, scattering, microscopy, mechanical, and rheological, weathering.
- Continuously modernized 1981, 1991, 2003
- Polymerization, compounding

OUTPUTS

- **Over three hundred publications with an average Impact Factor of 1.4**
- **About hundred and fifty patents filed in India and over seventy five patents filed globally**
- **Approximately thirty US patents granted**
- **Six U.S. patents licensed to companies outside India**
- **Over ten million US dollars worth of contract research funding during the last five years from companies, both in India and abroad**
- **On an average five students earn their doctoral degree in polymer science every year**

Key tasks

- Invent new technologies
- Protect intellectual property
- Comprehend the underlying science
- Transfer technologies to the client
- Understand products and processes
- Undertake basic research to support above activities

NATURE OF RESEARCH

- **Contract research**

Client driven

- **Basic research**

Curiosity driven

Build skills and competence

Conscious efforts to exploit results of basic research to undertake contract research

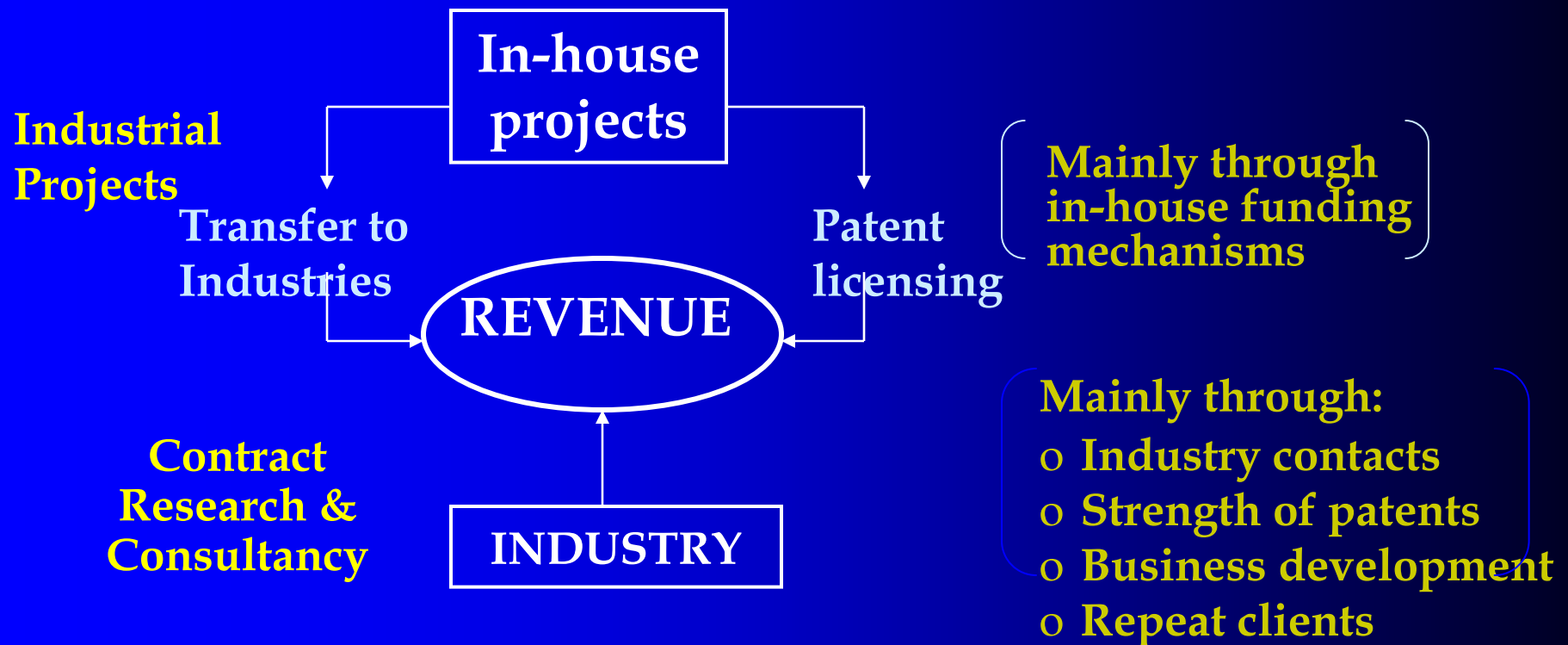
Client vs Curiosity driven R & D



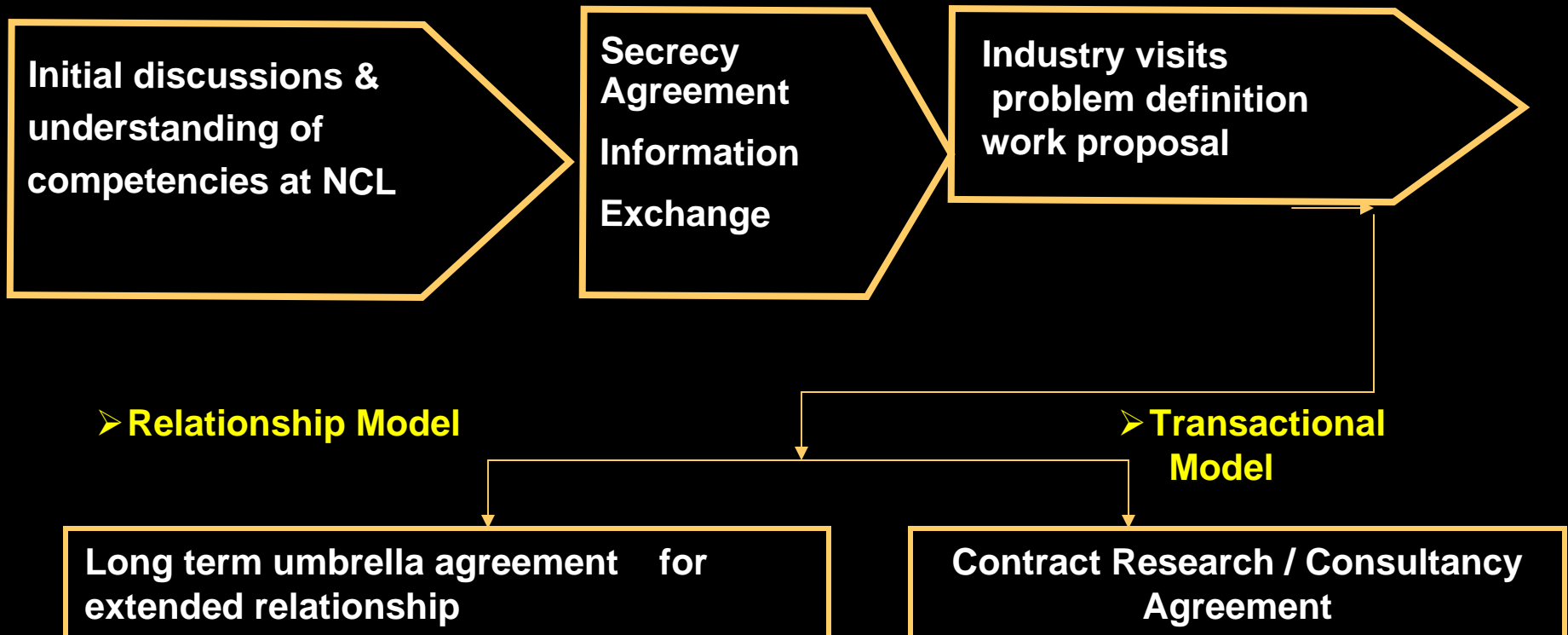
Services Offered

- Contract research
- Technical services
- Consultancy
- Human resource development

Business Model



BUSINESS INTERACTIONS



Project specific details as Annexures added continuously

INDUSTRY PROJECTS

```
graph TD; A[INDUSTRY PROJECTS] --> B[Contract Research]; A --> C[Consultancy]; A --> D[Technical Services];
```

Contract Research

- ❑ Business Driven R & D objectives with defined outputs
- ❑ Results in a product, process, tacit knowledge and IPR

Consultancy

- ❑ Professional advice

Technical Services

- ❑ Testing & Analysis
- ❑ Production of very specialized products

- Optimization / solutions to existing problems in operations
- Development of new processes
- New product development
- Generation of basic knowledge
- Evolving strategic technology road maps for business

Attracting and Nurturing Talent

- New recruitment in emerging areas
- New skills in conventional areas
- System in place to induct new blood
- Inflow of students from wider disciplines
- Course work for the students

Prominent Innovators

Innovator	Division	Filed	Granted
P Ratnasamy	Catalysis	37	31
S Sivaram	Polymer	47	28
R V Chaudhari	Catalysis	65	30
S Sivasanker	Catalysis	22	15
B D Kulkarni	Chem Engg	12	4
V R Choudhary	Chem Engg	43	29
M G Kulkarni	Polymer	36	11
M K Gurjar	Organic	12	4

GLOBAL CUSTOMERS (USA)

- DuPont
- General Electric
- Dow Chemicals
- Alcoa
- Schenectady Chemicals
- Medal Corpn
- Eastman Chemicals
- Polaroid
- Cargill Dow Polymers
- Proctor and Gamble

INDIAN INDUSTRY CUSTOMERS

POLYMERS

- Gujarat Apar
- Grasim Industries
- Garware Polyesters
- Reliance Industries
- Dura-Line India
- Bio-D Plastics
- ONGC
- Asian Paints
- Vinati Organics
- B.M Thakkar & Co.
- Hindustan Lever

PHARMACEUTICALS

- USV Limited
- CIPLA
- Ranbaxy
- RPG Life Sciences

Government Agencies

- Department of science & Technology
- Department of Biotechnology
- Department of Information Technology
- NMITLI initiative
- Department of Non Conventional Energy

POLYMER SCIENCE AND ENGINEERING : NCL-GE ALLIANCE

History

1993 : Initial contacts

1996 : Research Alliance Agreement signed ;
ever-green contract and sunset clause

1997 : Scope of alliance expanded

1999 : GE reaffirms intention to continue R&D
at NCL beyond 2000

Benefit sharing

Depending on nature of project ownership,
rights exclusive or joint

- GE provides monetary compensation to NCL for every US patent granted and every US patent practiced
- NCL scientists trained by GE on Six Sigma Quality initiatives in R&D

Funding

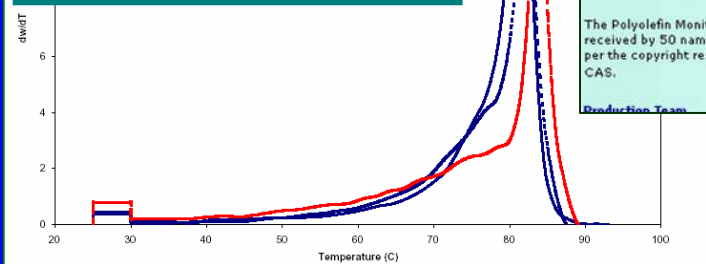
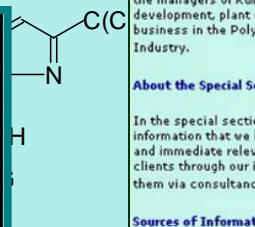
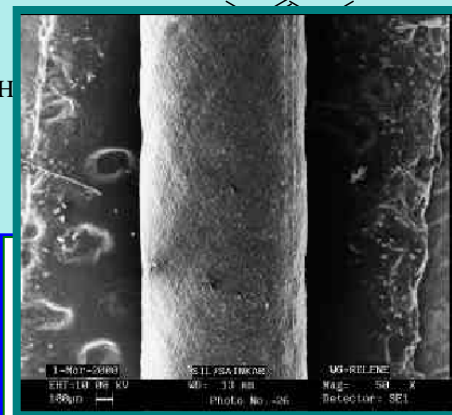
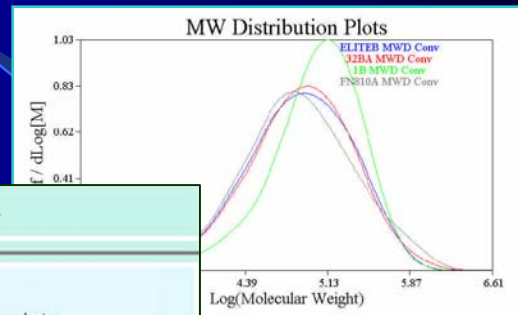
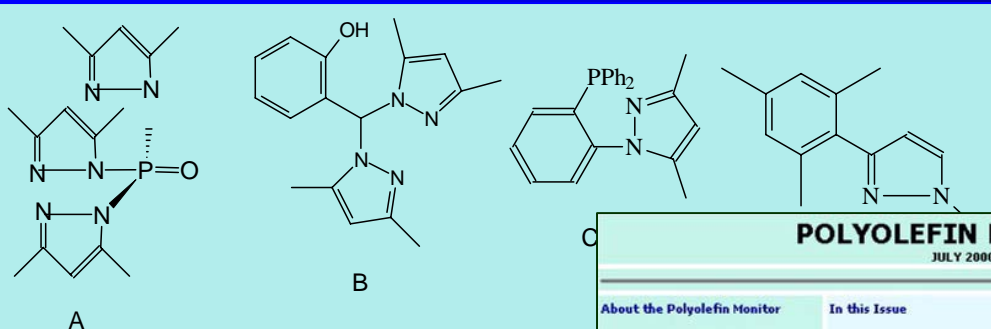
- Multiarea, multiprogram
- GE funding to NCL exceeds USD 7 million in the past eight years

NCL's contribution

- NCL-GE efforts have led to over 62 US patent applications in the area of PC technology
- 13 US patents have been granted
- NCL's contribution to GE's technology goals in polycarbonates has evoked wide interest and appreciation across GE's global sites
- NCL-GE relationship sighted as "Best Practice" case for all external technology programs across GE global sites

RIL-NCL Research Alliance 1998-2004

World Class R&D Services for the Polyolefins Industry



POLYOLEFIN MONITOR

JULY 2000

About the Polyolefin Monitor

The Polyolefin Monitor is an information monitoring service that provides focussed information for the managers of R&D, products development, plant operations and business in the Polyolefins Industry.

About the Special Sections

In the special sections, we cover information that we know is of direct and immediate relevance to our clients through our interaction with them via consultancy projects.

Sources of Information

The information in the polyolefin monitor is compiled from various sources: Chemical Business News (RSC), Chemical Abstracts (CAS) and various internet sources. The copyrights for the compiled abstracts remain with the original database companies.

Circulation & Restrictions

The Polyolefin Monitor can only be received by 50 named persons as per the copyright restrictions set by CAS.

Production Team

In this Issue

- Polymer production, polymerization and catalysis
 - Highlights and comments (Section 1.1)
 - Business news (Section 1.2)
- Phy
- Pla
- Pla
- Env
- Sig

Focussed Co

- Rel

POLYOLEFINS

Technology for Competitive Advan

Training program for the staff
Reliance Industries Limited.

Conducted by:
Polymers Business Group,
National Chemical Laboratory, Pur

© Copyright 2000, CSIR (National Chemical Laboratory, P

Fingerprinting and SPPR of Relene, Reclair and Repol

Grade-wise reports on the fingerprinting-benchmarking and Structure-Property-Performance Relationships analyses of Reliance polyolefin grades done at NCL between August 1998 and April 2001.

CONFIDENTIAL

August-April 2001

The Polymers Business Group
National Chemical Laboratory
Pune - 411008 INDIA
Web: <http://www.ncl-india.org>
Email: premnath@che.ncl.res.in

NCL's Contributions

Product knowledgebase

Product improvement strategy

Inputs for new product development

Improved understanding/
control/ optimization through modeling

In-house catalyst development

Ligands for novel catalysts

Replacement additives

Continuing education

Information monitoring and delivery

Technology management/
strategy

Value for Reliance

Improvements in product performance

Improved product consistency

New products with existing plant

Improved knowledge of products and processes

Reduced dependence on imports

Cost reductions

Possible intellectual property

Improved human capital

Informed decision making

R&D culture: R&D investments,
R&D center, PP pilot plant etc

NCL RIL Research alliance

- Seamless institutional relationship
- Mutual trust , confidence , respect
- Frequent informal consultations
- Exposure to the world of polyolefins

Summary

- Leading research group in the country
- Balance between curiosity and client driven research
- Emphasis on intellectual property
- Well defined business model
- Contemporary facilities and manpower