

# DST's Initiatives in Green Chemistry

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# GREEN CHEMISTRY

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“Green Chemistry is the design, development and implementation of chemical products and processes to reduce or eliminate the use of substances hazardous to human health and environment.”

# Green Chemistry Is About...



**Waste**

**Materials**

**Hazard**

**Risk**

**Energy**

**Environmental  
Impact**

**COST**

# What do DST- GC TF support ?

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- This program was started in Jan. 2004
  - Support all aspects of Green Chemistry
    - Research ( Open- ended, Industry Collaborative)
    - Teaching (GC- Experiments)
    - Training (Workshop, School etc.)
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# Some Statistics

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□ No. of Projects supported:

Open- ended : 18/84

Industry collab.: 6/6

Total cost : Rs. 550 lakh (507  
DST, 43 Industry)

□ No. of Workshops: 20

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# Research (open-ended)

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- ❑ Can be individual or group of individuals. Industry partner is not required.
  - ❑ Manpower, equipment, consumables, contingency and Travel are provided. Implementing institution to get 20% as overhead.
  - ❑ Novel ideas which might lead to exploitable green processes /products are supported.
  - ❑ Proposal should clearly mention the green chemistry principles ( as many as possible) involved in the work.
  - ❑ SERC project format to be used.
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# Projects supported ( Open-ended)

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1. How to make ionic liquids more effective for promoting organic reactions (NCL, Pune)
  2. Non- hazardous bromination with bromide/bromate couple obtained as intermediate of bromine recovery plants: Exploring studies on diverse applications. ( CSMCRI & IACS)
  3. Development and performance analysis of completely degradable polymer composites ( SK Univ. Ananthapur)
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## Projects supported (open-ended)

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4. Enhance biodegradation of polypropylene using biosurfactants (IIT, Chennai)
  5. Development of tailor made green packaging plastics (TERI, Bangalore)
  6. Remediation of metal ion contamination in Delhi soils using green approach (DU, Delhi)
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# Projects supported (open-ended)

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7. Developing membrane integrated hybrid reactor system for producing high purity lactic acid from renewable resources. The membrane integrated fermenter is expected to have better separation property and less energy consumption ( NIT Durgapur).
  8. Characterization and utilisation of waste plastics for various applications. To study the conditions of plastic road in cold regions, reuse of road scrap and also preparation of boards, blocks and iron rods with plastic coating ( TEC, Madurai).
  9. Developing fly ash reinforced polymer matrix composites to be used as green building materials like floor tiles, pavement tiles, etc ( Calcutta Univ. Kolkata)
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# Projects supported (open-ended)

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10. Synthesis of novel basic green catalysts (zeolite and mesoporous material based), and study their application for certain organic reactions ( Tezpur Univ., Tezpur)
  11. Exploring triarylbismuth as a new organometallic catalyst for C-C bond forming reaction ( IIT Kanpur)
  12. Development of nanocomposite based on natural resources (soya flour and jute fibre) ( Tezpur Univ., Tezpur)
  13. develop nanostructured membrane for solvent recovery applications. The membrane will be prepared from common polymers and cellulose derivatives and its performance will be compared with model nanofilter membrane available commercially ( NEIST, Jorhat)
  14. synthesize novel metal organic framework compounds with appropriate pore size and explore their uses as catalysts and for selective adsorption of gases ( IIT Kanpur)
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# Projects supported (open-ended)

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15. Synthesis of cobalt and copper based complexes, immobilize them on porous silica support and study catalytic application of the material in various organic transformations (Gauhati University, Guwahati)
  16. Developing benign process for synthesizing natural and synthetic glycolipids as potential biosurfactants using renewable feedstock ( NCL, Pune)
  17. Synthesis of novel heterocyclic systems using multi component reaction protocols ( Pondicherry Univ., Pudhucherry)
  18. Development of biodegradable plastics ( Basanti Devi College, Kolkota)
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# Research projects ( Industry Collaborative)

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- ❑ Proposal should have Industry partner.
  - ❑ Industry should contribute at least 30% of recurring budget.
  - ❑ Industry relevant problems are taken up.
  - ❑ Some illustrative problems are mentioned in the advertisement.
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# Projects Supported (Industry-Collaboration)

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1. Production of Calcium Magnesium phosphate fertilizer from low- grade phosphate ore and bulk circuit tailings of Jhamarkotra Plant, Rajasthan

MLSU & RSMML

2. Improved processes based on membrane for the recovery of acid and organic compounds.

CSMCRI & Atul

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# Projects Supported (Industry..)

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3. Production of biosurfactants from genetically engineered *Pseudomonas aeruginosa*.  
AU & Galaxy Surfactants
  4. Development of environment-friendly saccharification process for enhanced ethanol yield from rice straw.  
TERI and Praj Industries
  5. Study on the characterization and utilization of waste plastics.  
TEC & VTM
  6. Developing eco-composites using polylactic acid (obtained from renewable source), starch and reinforced with modified clay nanoparticles. This composite is expected to be eco-friendly and alternative to the existing petroleum based polymer composites  
(CIPET & Harita)
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# Industry Interaction

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At Ankaleshwar with Pigment Industry:

The following problems were identified to provide solution:

1. Replacement of aluminum chloride and salt in the production of CPC-green.
  2. Increase the number of substituted chlorine atoms from 15 to 16 in the chlorination process.
  3. Recovery / replacement of aluminum molybdate catalyst.
  4. Reduction / replacement / disposal of sulphuric acid.
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# Industry Interaction

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At Hyderabad with bulk drug manufacturers.

The following problems have been identified for providing solutions:

- (1) Removal of ammoniacal nitrogen from waste water.
  - (2) Value addition of secondary sludge.
  - (3) Conversion of sulphate to sulphur.
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# Workshop

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1. IICT, Hyderabad – Sept. 24-25, 2004
  2. IIT, Guwahati – Feb. 25-26, 2005
  3. MKU, Madurai – July 15-16, 2005
  4. Nirma, Ahmd - Nov. 25-26, 2005
  5. MSUniv. Baroda – Sept.22-23, 2006  
(Spl. Meeting with Industry rep.)
  6. NEERI, Nagpur - Feb. 13-14, 2007
  7. NIPER, Mohali - Sept. 3-4, 2007
  8. IICT, Hyderabad - Oct. 23, 2008 ( with Industry)
  9. JNTU, Hyderabad - Feb.14-15, 2009
  10. TEC, Madurai - Feb. 20, 2009
- and many other events were supported.
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# Other exercises:

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- ❑ Prepared Monograph on GC Experiments (UG, PG)
  - ❑ Some Green Chemistry Experiments were demonstrated
  - ❑ Dialogue with UGC to adopt the Monogarpth is planned
  - ❑ Interaction with Industry Representatives to provide solutions to some problems
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# APPEAL

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- Spread Green Chemistry
  - Practice Green Chemistry as much as possible
  - Submit proposals
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## INVITATION OF PROPOSALS UNDER THE GREEN CHEMISTRY PROGRAMME

Department of Science and Technology, Government of India, under the auspices of Science and Engineering Research Council, has launched a new programme in the area of Green Chemistry. Under this programme, the following activities will be supported:

- i. Industry – academia/national laboratories collaborative projects wherein definite financial contribution from industry is necessary.
- ii. Open ended R&D projects from academic institutions and national laboratories. These proposals should either have significant novelty or should result in potentially exploitable processes. The following are illustrative of some general ideas in this direction.  
Oxidation and Reduction using safe and non toxic reagents (preferably catalytic) ii) Bromination avoiding molecular bromine; iii) Reactions avoiding the release of toxic gases like HCN, HCl, NH<sub>3</sub>, Chlorine; iv) Alternatives for reagents like phosgene, potassium cyanide, AlCl<sub>3</sub>; v) Design and development of simple, environment friendly, cost effective catalysts for important chemical transformations; vi) Novel Reactions using enzymes and microbes with potential commercial application. vi) design of novel, green surfactants vii) design and synthesis of biodegradable polymers
- iii. Human Resource Development Programmes( workshops, symposia, etc.)

Proposals are invited throughout the year for the categories i. and ii. mentioned above. Details about the Human Resource Development programmes will be intimated later.

For industry–academia/national laboratories collaborative projects, the following problems have been identified and collaborators are encouraged to submit proposals in these areas:

- a) Improvements in processes based on sulphonation/alkali fusion where alternate processes are not attractive through recovery of acid and alkali via membrane separation.
- b) Development of new catalysts for Friedel-Crafts reaction in benign media.
- c) Greener separation processes.
- d) Use of heteropolyacid for industrially important processes in place of polluting processes.
- e) Nitration of pyridine and pyridine derivatives to realise the desired isomer in high yield as, for example, using N<sub>2</sub>O<sub>5</sub> in place of conventional methodology.
- f) Recovery of environmentally undesirable solvents from dilute solutions (<3%) such as DMSO, DMF, DMAc by membrane process.
- g) Resolution of racemates with the valorisation of unwanted isomers.
- h) Catalytic liquid phase oxidation/electrochemical processes for oxidation reactions.
- i) Greening of chromium industries from ore to final utilisation of metal.
- j) Catalytic processes for water purification and
- k) Catalytic processes for pulp & paper industry

The above areas are only illustrative in nature. The scientists, however, are encouraged to also submit proposals in other areas of Green Chemistry/Technology. The project format of “Drugs and Pharmaceuticals programme” of DST with appropriate modifications may be used for submitting proposals under this category.

For submitting proposals under the open-ended category, the SERC project format available at our website: [www.serc-dst.org](http://www.serc-dst.org) may be used. **All proposals submitted under the Green Chemistry programme should contain a one-page write-up at the end giving details as to how the present proposal encompasses many of the green chemistry principles.**

The scientists are required to submit 20 copies of the proposal to the following address:

Dr. R. Brakaspathy, Scientist 'G'

SERC Division, Department of Science and Technology

Technology Bhawan, New Mehrauli Road, New Delhi - 110 016.

Phone: 011 –26961916, FAX : 011- 26963695; Email: [rbpathy@ nic.in](mailto:rbpathy@nic.in)

The envelope may be superscribed "Green Chemistry – Industry collaborative projects or Open-ended projects" (as the case may be)

**There is no last date for receiving these proposals. They will be accepted throughout the year.**

# Contact details:

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- Our web site:

[www.serc-dst.org](http://www.serc-dst.org)

[www.dst.gov.in](http://www.dst.gov.in)

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**Thank You**

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