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Build India'99

INTERNATIONAL CONFERENCE AND EXHIBITION ON "WASTE BASED CONSTRUCTION MATERIALS & TECHNOLOGIES"

April 13-16, 1999
New Delhi, India

A REPORT

Organised by

Building Materials & Technology Promotion Council
Ministry of Urban Affairs & Employment, Government of India
G-Wing, Nirman Bhawan
New Delhi - 110 011
INDIA

with support from

UNIDO
International Centre for Science & High Technology (ICS),
Building L2, Area Science Park, Padriciano 99, 34012,
Trieste, ITALY

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REPORT

Report on the International Exhibition
Build India'99
and the International Conference on
"Waste and byproducts as Secondary Resources for Building Materials"
and
Film Festival
Pragati Maidan, New Delhi, India
13-16th April 1999

Organised by: BMTPC (India) — ICS (UNIDO)

Introduction:

Building Materials and Technology Promotion Council (BMTPC), a constituent of the Ministry of Urban Development, Government of India, organised a set of events, an International Exhibition **Build India'99**, International Conference on "Waste Based Construction Technologies" and a Film Festival during the period 13-16th April 1999. As many as 27 Indian organisations from public, private and NGO sectors and six International organisations participated in the exhibition. The exhibition attracted a very good participation both from India and other countries.

The exhibition was spread out in an area of 1300 sqmts. comprising 800 sqmts. inside and 500 sqmts. outside display area. In outdoor area actual machines demonstrating the production of waste based construction products were displayed. The exhibition received a wide response in the print and electronic media and over 6000 professional visitors from industry, decision-making sector, builders, engineers, architects, designers, house-holders, students and teachers, visited the exhibition. The **Build India'99** was co-terminus with two other events under the name and style of **Environment India'99** and **Water India'99**, exhibitions thread for the visitors evincing special interest in **Build India'99.** A Show-directory comprising of details of all participating organisations was brought out and widely circulated during the events.

The exhibition was inaugurated by Mr. Suresh Prabhu, Hon'ble Union Minister of Environment and Forests, Government of India and Inaugural Ceremony was presided over by Mr. Bandaru Dattatraya, Hon'ble Union Minister of State, Ministry of Urban Affairs and Employment, Government of India. Mr. Micheal Kafabusa Werikhe, Hon'ble Minister of State for Housing & Communications, Government of Uganda graced the Ceremony

with his present. He also participated in two Technical Sessions of the Conference besides spending substantial time at the exhibition and demonstrations. Mr. W.S. Nanayakara, Country Representative UNIDO in Delhi addressed the Inaugural Ceremony on the role of ICS in the area of New Materials and UNIDO in the areas of Investment and Technology Promotion and support to international programmes of technology sharing. Mr. Nanayakara also paid a visit to the exhibition alongwith the Ministers from India and Uganda.

Alongwith the above event, an international conference on **"Waste and By-products as Secondary Resources for Building Materials"**, was organised with the active support of the International Centre for Science and High Technology, UNIDO, Italy. The conference on account of the crucial nature of its subject and sub-themes, received a overwhelming response from the participants authors and speakers community.

The organisation of these events was successful in bringing together a high calibre of national and international Policy/decision makers, researchers, consultants and corporate sector representatives. Participants came from Australia, New Zealand, European Union, USA, Rwanda, Sri Lanka, Tanzania, Uganda, Zambia, Singapore etc. Multilateral agencies like UNIDO, Universities R&D institutes and Private Sector entrepreneurs also attended.

High quality research papers and case-studies were presented on following four themes:

I *Environmental Protection and Energy Saving thro Disposal and Recycling of Wastes.*
- *Wastes from Industry, Mines & Agriculture - Issues, Technologies and Future possibilities.*
- *The National Status on R&D, Standardisation, Commercialisation of Waste Management and Utilisation.*

II *Use of wastes - as important secondary resources for Cements, Blended Cements, Concrete, Walling and Roofing Building Components.*

III *Composites : present scenario, Composites as efficient and cost-effective options, Usage of Composites in Building Applications, Future Trends.*

IV Emerging technologies for Building Materials based on Bio-mass, Bamboo, Plantation Timbers and Fibres and other Lignocellulosnic wastes.

While there were over 150 delegates from India and abroad. These include 17 international speakers and participants coming from countries like Uganda, Australia, Italy, Tanzania, Kenya, U.S.A., New Zealand, Rwanda, Zambia, Sri Lanka and one representative of COMESA.

The foreign delegates included Mr. Micheal K. Werikhe, the Hon'ble Minister of State for Works, Housing and Communications (Housing), Ministry of Works, Housing and Communications, Govt. of Uganda, who shared the dias with the Hon'ble Ministers from India. The Hon'ble Minister from Uganda also participated in the deliberations of the Conference.

Opportunity was provided to all the foreign delegates to present their papers. It was satisfying to note that all the presentations, both Indian and International, were received very well and generated active participation from the floor during all Technical Sessions.

The Conference, Exhibition (Build India'99) and the Film Festival provided an in-depth overview of the status of Building Materials sector, research results, commercial utilisation of research findings and best practices and constraints in promoting innovative technologies.

A pre-conference document comprising of 45 papers under the four sub-themes from authors within and outside India was produced and given to the delegates at the time of registration on 13th April 1999.

The international delegates specially thanked the BMTPC for identifying them on account of their nature of work and specialisation in the field of wastes and byproducts for useful building materials. They also expressed gratefulness to ICS UNIDO Italy for supporting the twin events and particularly the funding for travel of the international delegates. The delegates had a great appreciation for ICS UNIDO Italy and BMTPC for making the local arrangements and conducting the conference in a true professional manner with all the modern gadgetry of multi-media presentations, slides overhead projection in the state-of-the-art conference hall in the exhibition venue itself.

Coinciding with the events was an International Film Festival in which 72 films were received as entries. Sir M.A. Partha Sarathy, a film maker and well known figure in international conservation circles and the President of the World Environment Education Union (Switzerland) and Chairman, International Nature Film & Television Festivals Organisation, chaired the Jury which included Mr. H.F.Kroll, Ms.Marilyn Suckle Gigli. Ms.Chic Hori and Ms. Nirupama Raina. All the films adjudged best and few others were shown in the Film Festival spread over 13-16th April 1999. The Jury adjudged 6 films worthy of award.

Two films produced by BMTPC were also selected for Award presentation as follows:

S. No.	*Title of the Film*	*Category*
1.	**Shelter for All**	*Best Film on Waste Based Construction Materials and Technologies*
2.	**Build a Safer Tomorrow**	*Best Film on Corporate Support to the Environment.*

A cultural evening was also organised for the Conference delegates on the 13th April 1999 wherein a renowned Odissi Dancer Ms. Shagun Bhutani made presentation of Indian classical dances. The classical dance presentation reflecting the true Indian faith and ethos, moved the audience and it was appropriately followed by a reception at the India Habitat Centre, New Delhi. Both the cultural evening & reception and the dinner were graced by the Hon'ble visiting Minister of State from Uganda and all the delegates from outside India. The Hon'ble Minister of Uganda also visited a recently completed Housing Project and also had a meeting with Union Minister of Urban Affairs, Government of India and discussed the matters of bilateral interest.

Proceedings of Technical Sessions, the Resolutions and Recommendations of the Conference, some papers which could not be included in the pre-conference publication and some important photographs taken during the events have been compiled and are presented in this Post-Conference Publication. The printed copies of second volume will be furnished by June'99 end.

(T.N. Gupta)
Executive Director BMTPC

RECOMMENDATIONS

RECOMMENDATIONS

The Conference recognised:

- CONCERN for ever growing requirements of housing and infrastructure in the developing countries leading to exponentially rising demand and severe shortages of cost-effective building materials.

- MATERIALS industry for housing and building sector in most African countries has increasingly become dependent on import of materials and in several cases even import of raw materials.

- CAPITAL intensive advanced technology based manufacturing methods are not feasible to meet the need of building materials in many African and south-east Asian countries.

- A STRONG OPTION to meet the rising demand of building materials is to develop and promote innovative composite materials based on local resources and wastes from industry, forestry, agriculture, etc.

- THE MATERIALS produced from wastes, by-products, residues, natural fibres and plant materials are environment friendly and energy efficient. Availability of wastes, by-products, residues in most countries can help in setting up sustainable production units of building materials.

- BESIDES being cost-effective industrial production of composite materials from local resources would help in environmental protection and conservation of energy.

- COUNTRIES in south-east Asia (particularly in India) and in Africa have achieved good/differential progress in the development, production and adaptation of composite building materials.

- LARGE GAPS exist in research and development of composite materials and practical application in housing in most African countries.

- EXTENSIVE collaboration and international cooperation amongst developing countries in Africa and south-east Asia will greatly help in promoting investment and technology sharing/transfer in the building materials sector to meet the housing needs in respective countries. Such cooperation will also help in strengthening industrial production of materials.

In view of the above concerns, the following major recommendations emerged from the deliberations:

1. In keeping with the basic approach of ICS and UNIDO a comprehensive programme of cooperation among the selected countries of Africa and Austro-asia need to be developed to facilitate continuing cooperation. To initiate this programme the Conference recommends to form a central Steering Body which could be designated as "Building Materials and Technology Development Council for Africa and South-East Asia".

2. The Building Materials & Technology Development Council for Africa and South East Asia may formulate 2 or 3 regional programmes of R&D on eco-friendly and energy efficient new building materials and construction primarily based on locally available resources, industrial and mining wastes (slags, tailings, ashes etc.) and residues and fibres of natural plants and agricultural products. In this task all the known technologies in the form of technology packages, should be made available, so that the related know-how could be widely disseminated.

3. The Conference while recognising the significant work done in India in the area of Natural Disaster Mitigation and Management recommends that all the knowledge of the designs, standards, specifications and codes of practices of disaster resistant houses should be compiled and given to all such countries which unfortunately face the natural disasters and other causes.

4. Almost all the building materials industries and the construction technologies cause extensive emissions of pollutants in solid, liquid and gaseous forms, and in some of them a host of hazardous heavy metals and toxic chemicals that pollute the surface and sub-surface water. It is recommended that a comprehensive document should be prepared on the pollutants and hazardous constituents from building

materials and construction industries and formulate the required international standards on the permissible emissions in various locations where the industries are located. An additional document should also be prepared on the known avenues/technologies through which the hazardous wastes could be converted into non-hazardous types to facilitate their profitable utilisation.

5. Recognising the vital importance of energy conservation in the building materials sector, there should be a shift from fired to unfired building materials for African and Asian developing countries, there could be four materials of the future for affordable shelters for all. These four materials are light weight or hollow concrete blocks & stabilised solid blocks using inorganic wastes, steel and aluminium (particularly the recyclable types), bamboo and agricultural and forest residues based fibres. Most of the proposed development work should centre around these four materials, particularly for cost-effective composites.

6. To achieve the objectives of the above recommendations, through very close cooperation and collaboration, let all the countries participating in this conference may be approached by the Building Materials and Technology Promotion Council of India (BMTPC) to obtain the willingness of the Chief Executive of science and technology institutions and the government for participation in a Programme on Materials & Housing through the proposed nodal agency of "Building Materials and Technology Development Council for Africa and South-east Asia".

7. National Governments need to promote productivity as well as bridge the gap between research findings and wide-scale application by promoting investment and technology transfer amongst the developing countries of Africa and south-east Asia.

8. The international agencies like UNIDO, ICS, UNCHS, World Bank, UNDP, UNEP, should be requested to encourage technology sharing, training in new production methods, and set up demonstration projects jointly with established formal/informal sector producers for disseminating information on improved production methods.

9. The ICS, UNIDO and UNCHS be requested to organise such Research-Industry get-togethers/workshops/conferences, at least, once in two years.

10. The participants from various countries appreciate the efforts made by the Building Materials and Technology Promotion Council, Ministry of Urban Development, Government of India in organising the International Conference and Exhibition in collaboration with ICS and UNIDO. The Conference recommends that the BMTPC should assist ICS and UNIDO in developing a Cooperation Programme between South East Asian and African countries to strengthen the International Data Base on the subject and to facilitate technology development and transfer between the willing countries from the two regions.

PROCEEDINGS

TECHNICAL SESSION I

Date: 14.4.1999
Time: 0930-1130 hrs

Environmental Protection and Energy Saving Thro Disposal and Recycling of Wastes.

– THE NATIONAL STATUS ON R&D, STANDARDISATION, COMMERCIALISATION OF WASTE MANAGEMENT AND UTILISATION

Chairman	:	**Shri V.Suresh, Chairman & Managing Director, Housing and Urban Development Corporation, Ministry of Urban Development, Govt. of India**
Co-Chairman	:	**Dr. Giorgio Bressi, Milan, Italy**
Rapporteur	:	**Dr.(Miss) Mohini Saxena, Scientist, Regional Research Laboratory, Bhopal, India**

Papers presented:

Sr. No	Speakers	Country	Title of the Paper
1	Richard Ley, Arif Humayun	USA	Coated Sheet Steel for Construction – Eco-Friendly, Energy Efficient and Cost-Effective
2	Giorgio Bressi	Italy	Recycling of Construction and Demolition Waste: The Italian Technology
3	Vimal Kumar, C.N.Jha, Preeti Sharma	India	Fly Ash - A Fortune for the Construction Industry
4	Carlo Valente Peracino, A.Moz.	Italy	Urban and Industrial Waste Recovery as Raw Material for Ceramic Bodies
5	Sarah Ibanda	Uganda	Environmental Protection and Energy Saving through Disposal and Recycling of Wastes: Wastes from Industry, Agriculture and Future Possibilities - Uganda Chapter
6	R.N. Iyengar	India	Solid Industrial Wastes as Secondary Resource Material in Building Sector
7	V. Sriraman, Arun Kumar	India	Waste based Building Materials

Paper 1 Coated Sheet Steel for Construction – Eco-Friendly, Energy Efficient and Cost-Effective

Presentation by Mr. Arif Humayun

Mr. Arif Humayun presented the paper highlighting the salient features. The paper claims the coated sheet steel as ecologically friendly, energy efficient and cost-effective material-alternative to wood and brick. it is claimed that coated sheet steel is 100% recyclable and 55% Al-Zn coated sheet can be used as an excellent reflector of solar radiation.

Mr. Arif Humayun also presented case studies of the application of the coated sheet steel over existing roofs, adding very little additional load, in graphics Packaging Corporation Reading, Pennsylvania (USA); renovation of an old roof in Tube Products - Plant Roof, Troy, Ohio (USA); in Marine/Industrial Roofing and Sliding Application at Keppel Distripark, Singapore, and several others of uses in sliding (sloping) roofs in residential roofing as well as in various roofs of the Sydney 2000 Olympic Games Facilities. He further claimed, through various data on thickness, load, wind resistance, resistance to fire, moisture, earthquake, corrosion, energy efficiency, cost-effectiveness and environmentally friendly nature of this coated sheet steel.

In response to a series of questions from the audience, within the limited available time, the author explained various points to the extent the data quoted in half-a-dozen `Case Studies' included in the Appendix of the paper, and he invited the fellow delegates to initiate correspondence for obtaining specific details. Mr. Humanyun has later sent specific written replies to the questions raised in his presentation.

Paper 2 Recycling of Construction and Demolition Waste: The Italian Technology

Presentation by Dr.Georgio Bressi

The full text of this paper could not be included in the Proceedings Volume I.

Dr. Georgio Bressi presented his paper on `Recycling of Construction and Demolition Waste : The Italian Technology', with the help of various slides. He explained various details of recycling of construction and demolition wastes. In fact, the utilisation of demolition wastes, by first applying the processes of selection and segregation of various wastes, such as concrete, steel, aluminium, wood, plastics and other materials, and then crushing, grinding, sieving and grading was amply shown in the slides. The data on final uses in concrete and other recycling processes were also presented.

Many delegates sought to know about the details of segregation and collection methodologies, logistics, physical and chemical properties the materials finally prepared for construction, related standard specifications, any deleterious effects, durability, life cycles and comparative costs.

The author explained various points in as much details as time permitted and emphasised that such technologies in Italy as well as in several other European countries have been standardised and are in common practice of construction.

Paper 3 Fly Ash - A Fortune for the Construction Industry

Presentation by Dr. Vimal Kumar

Dr. Vimal Kumar presented his paper covering almost all aspects handing, collection, distribution, standardisation and utilisation of flyash in India. Dr. Vimal Kumar in his capacity as Flyash Mission Director, in the Technology Information Forecasting and Assessment Council (TIFAC), Department of Science and Technology, Govt. of India, presented the entire spectrum of flyash collection and utilisation in buildings, roads, embankments, waste land development for agricultural purposes and stabilisation of flyash ponds and human settlements in those areas.

The details about various commercial plants on the manufacture of flyash-based clay bricks, autoclaved and unautoclaved cellular concrete, Fal-G bricks, flyash sand-lime bricks and hollow concrete blocks were also presented by Dr.Vimal Kumar.

Paper 4 Urban and Industrial Waste Recovery as Raw Material for Ceramic Bodies

Presentation by Mr. A.Moz

In this paper the issue of the disposal of both municipal and industrial wastes has been highlighted. The Welko Industries S.p.A., Italy claims to be a major supplier of ceramic tiles manufacturing equipment to Vortec Corporation of USA. The Welko have developed a technology of making tiles, by vitrification at about 1500°C, from flyash, sewage sludge or other industrial residues. The composition of the raw materials could be 70% wastes and 30% clays and other ingredients to produce ceramic tiles to high quality.

By recycling, bulky and hazardous wastes through vitrification are often transformed into value-added non-hazardous building materials.

The points of interest as evinced by the delegates brought out the fact that a variety of ashes of divergent origins such as municipal incinerators, spent pot liners, foundries, car destruction, coal ashes and various contaminated wastes are suitable materials for utilisation in the process.

The author claims that the vitrification of the wastes into ceramic tiles of almost zero porosity, water absorption as low as 0.5% and very high strength are attainable even at as low temperature as 1040 to 1100°C. The concept can be extended into production of sanitaryware and bricks, and may be even dinner ware.

Paper 5 Environmental Protection and Energy Saving through Disposal and Recycling of Wastes: Wastes from Industry, Agriculture and Future Possibilities - Uganda Chapter

Presentation by Ms. Sarah Ibanda

Ms.Sarah Ibanda presented the paper covering the scope of disposal and recycling of a large number of inorganic and organic waste materials of Uganda. The author presented a list of many waste materials and described the present methods of disposal & recycling. She also stated that Uganda in its vision 2025 aspires to have a "science and technology driven country, with adequate infrastructure coordinated information network and sustained socio-economic growth, which ensures environmental quality and reservance of the eco-system".

Paper 6 Solid Industrial Wastes as Secondary Resource Material in Building Sector

This paper by **Dr.R.N.Iyengar** was presented by Dr.J.M.Bhatnagar.

This paper gives a comprehensive review of the solid industrial wastes as secondary resource materials in building sector. Various examples of work carried out in the Central Building Research Institute, Roorkee were highlighted. The main uses of flyash in burnt-clay brick, sand-lime brick, flyash cellular concrete blocks, light weight aggregate and red mud bricks were explained. The example of some organic wastes and fibres in making panel products, roofing sheets, blocks were also included.

Regarding a question on the use of paper sludge waste, the house was informed that paper sludge had to be calcined before it could be used in building materials.

Paper 7 Waste based Building Materials

Presentation by Dr.Arun Kumar

The paper presented by Dr.Arun Kumar briefly explained the Indian construction scenario. Data on demand for houses made from burnt-clay bricks and concrete, future projection of the demand of building material, environmental implications and problems of pollution, CO_2 emissions of roofing systems, energy consumption in roofing systems and impact of technology on net energy demand for building materials were presented through various slides.

Further a couple of low energy-consuming building materials were suggested, such as building bricks from flyash+sugar industry lime sludge waste with just 5% of fresh lime. Soil+stone dust+cement bricks and blocks were also proposed. The physical properties of these two types of bricks were quoted as compressive strength 30kg f/cm^2 and water absorption 15 to 20 per cent.

In two types of the bricks about 5% lime and 6% cement respectively were used. Perhaps 5% lime may not be necessary if the bricks are made after light firing when the inherent organic matter in the lime sludge provides the energy, and in the stone dust 6% cement as stabiliser appears to be high for just attaining 30 kg f/cm^2 compressive strength. However, utilisation of locally available materials could be the main salient feature of the work reported.

TECHNICAL SESSION II-A

Use of Wastes - As Important Secondary Resources for Cements, Blended Cements, Concrete, Walling and Roofing Building Components.

Date: 14.4.1999
Time: 1200-1300 hrs

Chairman : **Dr. K.Satyanarayana, Director, Regional Research Laboratory, Thiruvananthapuram**
Co-Chairman : **Dr. Debes Bhattacharyya, New Zealand**
Rapporteur : **Mr. J.Sengupta, BMTPC, New Delhi**

Sr. No	Speakers	Country	Title of the Paper
1	Walter Merzagora, Ariel Paggi	Italy	Use of Tannery Sludges in a Brick Factory for the manufacture of Bricks and Tiles
2	G.Balasubramanian, M.T.Nimje, R.S.Mishra, T.R. Ramachandran	India	Utilisation of Metallurgical Wastes in the Building Material Industry
3	Deepak Narayan, Jose Kurian	India	Use of Blended Cement in Concrete Construction in India
4	P.G. Lele, V.K.Gore, S.A.Khadilkar, R.M. Cursetji	India	Valorization of Industrial Wastes through use in Cement Manufacture- Illustrative Case Studies
5	C.B. Raju, B.Chakradhar, J.Prabhakar, Prabha Padmakaran, R.S.Ahirwal, M.Saxena, Amit Rai	India	Study on Some Special Features of Slags from Ferroy-Alloy Industry for Exploring New Construction Materials

Paper 1 Use of Tannery Sludges in a Brick Factory for the manufacture of Bricks and Tiles

Presentation by Mr. Ariel Paggi

Mr. Paggi highlighted the important parameters required for making brick utilising tannery sludges. The investigation carried out are based on various conditions under which bricks could be manufactured from the tannery sludges. Emission from the pilot kiln used for firing the bricks have also been studied. Environmental benefits & energy balance using sludges were explained with illustrations. It was pointed out that a legislative decree from the Govt. have allowed this technology with some limitations and restrictions.

The paper gives detailed descriptions of the following aspects of the investigations:

(a) Different conditions under which no oxidation of Cr^{3+} to Cr^{6+} could occur in brick manufacture.

(b) Control of emissions from the kiln during burning
(c) Methods to eliminate odour
(d) Quality characterisation of the finished products
(e) Evaluation of industrial feasibility, and control of bad smell during firing.

The major advantages claimed were utilisation of a waste taking into consideration the energy content of the high organic matter in tannery sludges, and production of light weight cellular bricks and tiles.

Discussions

This paper generated a good deal of interest among the delegates and detailed discussions were held with Dr.Paggi during spare time.

Paper 2 Utilisation of Metallurgical Wastes in the Building Material Industry

Presentation by Dr. G. Balasrubramaminan

Dr.G.Balasubramanian, presented this paper, yet about another hazards waste - Red Mud.

The paper provides various information such as chemical composition; global utilisation of red mud and spent pot lining, a waste generated from aluminium industry. R&D work carried out by various organisations were presented with special reference to the recovery of valuable components such as fluoride caustic soda, carbon and red mud in building materials industry including glass ceramic materials. It was concluded that utilisation of red mud in building material industry as well as for recovery of precious metals were technically and economically viable.

The authors have claimed that valuable metals which could be recovered from red mud are iron, alumina, vanadium, titanium dioxide, chromium, thorium, zirconium, ghalium, etc.

This paper presents various possibilities of utilising zinc industry waste, steel plant waste, copper mine tailings etc. along with the red mud from aluminium industry in the development of glass-ceramic materials such as tiles, wall coverings, bricks and pipes. Perhaps it is important to take into account the proximity of the availability of various wastes, their collection, storage, processing etc. The cost factor has also to be kept under consideration.

Discussions

The paper was considered by several delegates as a very good review of the scope of work on utilisation of wastes as resources for development of high-value ceramic and glass-ceramics.

Paper 3 Use of Blended Cement in Concrete Construction in India

In his paper Mr. Deepak Narayan and Mr. Jose Kurian have emphasised importance and advantages of blended cement manufactured from flyash, blast furnace slag, silica fume, rice husk etc. for construction industry. It has been informed that manufacturing and use of blended cement have already been started in India. It has been concluded that use of flyash, rice husk, slag, silica fume for manufacturing of blended cement will contribute towards sustainable development. However they have put a word of caution about wide spread use of PPC for general use particularly with respect to corrosion and curing. They have suggested some measures for overcoming these problems.

Some other important advantages in the manufacture of blended/portland pozzolana cements highlighted by the authors are low emission of CO_2 into the atmosphere and low heat of hydration minimising the chances of cracking, principally because blended cements have lower percentage of Ordinary Portland Cement (high strength, early strength types particularly) in them. Thus cumulatively there would be lower CO_2 emissions and consequently less green house effect.

Since both the authors could not attend this seminar, the paper could not be personally presented and discussed. As the high volume flyash, high volume ground granulated blast furnace slag (GGBFS) and silica fume containing concrete today is the order of the day, this paper attains special interest for the Indian construction industry.

Paper 4 Valorization of Industrial Wastes through use in Cement Manufacture- Illustrative Case Studies

Presentation by Mr. P.G. Lele

The paper presented by Mr. P.G.Lele has highlighted some important investigations carried out by ACC on the utilisation of industrial wastes like lime sludges from paper industry, sugar and fertiliser industry, aluminium industry, by product. Chemical gypsum, fluoride. Since ACC are one of the major cement manufacturers the experimental trials reported in the paper may assume vital interest among the R&D workers in cement chemistry and technology. It was concluded that waste valorisation is a definite area of cement technology.

Discussions:

Dr.J.M.Bhatnagar discussed with the author about addition of CaF_2 (Calcium fluoride) in the raw mix, and whether it would be increasing the fluoride emission & how it could be controlled.

Paper 4: Study on Some Special Features of Slags from Ferroy-Alloy Industry for Exploring New Construction Materials

Presentation by Dr. C.B. Raju

Dr.C.B.Raju presented his paper on the exploration of metallurgical slages with particular reference to ferro-manganese alloy steel industry. The results of the study carried out by the author on the nature of these materials have been reported. It has been explained how various properties of building bricks like strength, density can be improved. It has been recommended that these slags can be explored for manufacture of light weight and high strength materials for building construction with special reference to thermal and sound insulation.

The paper contains special data on likability of the raw materials, their evaluation and characterisation, and x-ray and CEM figures identifying the major phases present in the fired products.

The work was considered very interesting in view of large quantities of metallurgical slags available as waste materials.

Discussions:

In general the delegates wanted to know about the variability of physical, mineralogical and chemical properties and also the hazardous constituents present in these slags. The emphasis may be given about detailed characterisation and standardisation of the slags, and adopt suitable techniques for various fired products to be produced.

TECHNICAL SESSION II-B

USE OF WASTES - AS IMPORTANT SECONDARY RESOURCES FOR CEMENTS, BLENDED CEMENTS, CONCRETE, WALLING AND ROOFING BUILDING COMPONENTS

Chairman : **K. Satyanarayana**
Co-Chairman : **Debes Bhattacharyya, New Zealand**
Rapporteur : **J.Sengupta, BMTPC, New Delhi**

Paper Presented

Time 1400-1500 hrs

Sr. No	Speakers	Country	Title of the Paper
1	P.C.Borthakur, D.Bordoloi, A.C.Baruah, P.Barkakati	India	Promotion of Small Scale Cement Manufacturing Based on Agro-Industrial Waste
2	S.Gopalakrishnan	India	Durable Concretes using Mineral Waste Materials - An Overview of SERC's Experience
3	K. Ramamurthy, N.Narayanan	India	Influence of Flyash on the Properties of Aerated Concrete
4	R.Krishnamurthy, A.K.Mathur	India	Ash Utilisation in NTPC
5	O.P.Ratra	India	Plastics Waste: Environmentally Potential Source for Composite Materials and Energy Recovery

Paper 1 Promotion of Small Scale Cement Manufacturing Based on Agro-Industrial Waste

Mr. P.C. Borthakur, and co-authors could not participate in the conference. The paper contributed by them enlists to large quantity of agro-industrial waste generated in the country. The paper deals in rice husk and bamboo dust. Rice husk is generated during milling of the paddy and bamboo dust is obtained during processing of bamboo for pulping. Disposal of these agro industrial waste is a problem specially as these are of low density, high volume. These are very slow bio-degradable. The Regional Research Laboratory, Jorhat investigated the utilisation of both rice husk and bamboo dust as fuel for manufacturing cement in small scale in place of coal. The caloric value of these wastes are over 3000 K cal/kg. The clinker produced by using these agro wastes are soft and porous due to high amount of volatile matter in the waste. Utilisation of rice husk, bamboo dust as fuel for manufacturing cement will lead to sustainable management of the waste. Ash generated can be consumed as constituent of the clinker. The process developed can be used for manufacturing cement in small scale vertical shaft kilns.

Paper 2 Durable Concretes using Mineral Waste Materials - An Overview of SERC's Experience

Maintenance and repair of constructed facilities is a growing problem in reinforced concrete structure, such as bridges, multi-storeyed buildings, hyperboloid cooling tower and chimneys, particularly in coastal regions.

This paper presented by Dr. Gopal Krishnan contains generally an overview of the R&D carried out at Structural Engineering Research Centre Chennai (India) using flyash and blast furnace slag in High Performance Concrete (HPC) to improve the durability, fracture, toughness, ductility and abrasion resistance of concrete. It was observed that flyash based HPC mixture imparted high resistance to corrosion, low water absorption and high resistance to chemical attacks. The paper deals with overall scenario of concrete technology, durability of cement concrete, high performance concrete and R&D efforts. It concludes with the recommendations to make use of high performance concretes to ensure durability of structure.

Paper 3 Influence of Flyash on the Properties of Aerated Concrete

Presentation by Dr. K. Ramamurthy

Dr. K. Ramamurthy presented the paper which deals with the use of flyash in concrete as replacement of sand finer than 300 micron, between 0 and 100% in stages of 20% alongwith moist and autoclave curing. The basic cement/sand or flyash ratio was maintained at 1:3 by weight. Autoclaved specimens were subjected to a pressure of 10 kg/cm^2 for 8 hours duration and allowed to return to ambient conditions overnight. Strength tests were conducted on the 28th day. The strength of cement flyash autoclaved mixes is slightly higher than that of corresponding moist-cured product. Study concludes that

i. depending upon the desired density and strength of aerated concrete, replacement of varying percentages of sand with flyash gives better results.
ii. for a particular density, increase in flyash content of the mix will result in an increased strength.

Discussions:

In general discussions were held with the author during the lunch period and some doubts were expressed regarding the statement in the conclusion that flyash contained less reactive silica than fine sand. If the strength enhancement with the addition of flyash in aerated concrete on autoclaving is not significant then it contradicts the conclusion at no (ii).

Paper 4 Plastics Waste: Environmentally Potential Source for Composite Materials and Energy Recovery

Presentation by Mr. O.P. Ratra

Mr. O.P. Ratra while presenting his paper pleaded not to get alarmed with the problem of disposal and recycling of plastics wastes. He also discounted the general impression of high toxicity generated on recycling of waste plastics and thought that such problems could be effectively tackled. Plastic waste, generated mainly because of plastic packaging, health and medicare, forms part of municipal solid waste(MSW) and is called post consumer waste. The paper described about the present status of plastic wastes in India and scope for developing it in building products/components. The paper mentions about 2 million tonnes of plastic waste expected to be generated by 2001-2002. Besides conventional recycling options there is need to undertake applications development research on volume of products. The option will reduce load on landfills by reducing the volume of waste and generate energy. The author describes many composites which could be made by recycling of waste plastics.

TECHNICAL SESSION III

Date: 15.4.1999
Time: 0930-1130 hrs

COMPOSITES : PRESENT SCENARIO, COMPOSITES AS EFFICIENT AND COST-EFFECTIVE OPTIONS, USAGE OF COMPOSITES IN BUILDING APPLICATIONS, FUTURE TRENDS

Chairman : T.N.Gupta, ED, BMTPC
Co-Chairman : ETN Bisanda, Tanzania
Rapporteur : C.B.Raju, RRL, Bhopal

Paper presented:

Sr. No	Speakers	Country	Title of the Paper
1	Debes Bhattacharyya, K. Jayaraman, M. Bowis, C. Boyle	New Zealand	Waste to Product Manufacturing : A Scenario with Waste Plastic/Natural Fibre Composites
2	V.T.L. Bogahawatta, N.B.M. Ranatunge	Sri Lanka	Agricultural and Industrial Wastes as Secondary Resources for Building Materials - Present State and Future Prospects in Sri Lanka
3	K.G. Satyanarayana, K.G.K.Warrier, C.Pavithran	India	Development of Building Materials based on Agro and Industrial Wastes and Innovative Processes
4	D. Ruys, Alan Crosky, W.J.Evans	Australia, UK	Ecologically Sustainable Composite Materials for Low Energy City Vehicles
5	Wambuzi Ivan	Uganda	Institutional Arrangements for Utilisation of Waste-based Building Technologies in Uganda
6	Maria Joao Nazareth, Fernando Amade	Mozambique	Indicative to Design Building Materials from Recycled and Natural Products of Mozambique
7	G.B. Singh A. Anjaiah	India	Normally Cured, Site Produced, Flyash based "Cellular Light weight Concrete" Flyash in the Production of Building Materials - A Case Study of Pioneering Initiative
8	N. Bhanumathidas, N.Kalidas	India	The Rationale for Portland Pozzolana Cement Composition
9	Ved Prakash	India	Fly Ash Products as Resource for Alternate Building Material

Paper 1 Waste to Product Manufacturing : A Scenario with Waste Plastic/Natural Fibre Composites

Presentation by Professor Debes Bhattacharyya

Professor Debes Bhattacharyya presented the paper highlighting the importance of the best methods of recycling of waste plastics. In view of the limited applications of goods made by recycling waste plastics along, the authors have proposed introduction of wood fibres in the composites with improved mechanical properties. The paper describes a noval method of production process and presents data on tensile strength, tensile modulus, flexural modulus and flexural strength for the composites prepared with recycling of plastics waste itself and those with upto 40% wood fibres.

The authors claims to have developed a dry mat formation process using thermoplastics and wood fibre. They further point out that the key deformation mechanism for layered wood fibre-plastic composite sheet is interplay shear while intraply shear deformation dominates deformation of relatively homogenous sheets. A key benefit of wood fibre reinforcement is said to eliminate the tendency of the thermoplastic to exhibit localised tensile instabilities; and also the complex parts can be theremoformed successfully from these composites with enormous potentials of industrial applications, with possibilities of recycling atleast upto 5 times.

Discussions

Dr. C.B. Raju and Dr. (Miss) Mohini Saxena evinced keen interest in the work of Dr. Bhattacharyya and colleagues as their institute is also engaged R&D in several types of composites. They desired to have further close contact and collaboration with the authors. The BMTPC staff members also expressed similar remarks.

Paper 2 Agricultural and Industrial Wastes as Secondary Resources for Building Materials - Present State and Future Prospects in Sri Lanka

Presentation by Dr. V.T.L. Bogahawatta

Dr. V.T.L. Bogahawatta and Mr. N.B.M Rantunge presented their paper briefly narrating the scope of further work at their laboratory in Sri Lanka, mainly on the building materials from activated clays, lateritesl timber products (particularly plantation timbers) and rice husk ash cement. The authors also described the work carried out by them on the pozzolanic properties of burnt wood dust and coir dust, and ash of bagasse, cane leaves etc. Further scope of work on other wastes such as quarry dust, lime sluges and sulphite liquor from paper industry were also mentioned. The authors claim to have come to some tentative conclusions regarding optimum temperature and duration of firing the organic wastes, and clayey materials to produce a highly reactive pozzolana for use in lime-pozzolana or cement-pozzolana (portland pozzolana cement). The authors claimed to continue and intensify their work on the utilisation of wastes and byproducts, both organic and inorganic.

Paper 3 Development of Building Materials based on Agro and Industrial Wastes and Innovative Processes

Presentation by Dr. K.G. Satyanarayana

Dr. K.G. Satyanarayana presented a detailed review of the work on the development of building materials utilising agro/industrial wastes carried out in the Regional Research Laboratory, Thiruvananthapuram (India). The paper included various characterisation data on agro-wastes, physical and mechanical properties and microstructure of some fibres. The paper further claims that processes have been developed for the production of 'Poly-Coir' door panel and shutter with excellent mechanical properties, long durability and good acoustic properties. The authors describe several other processes of making flyash bricks, coir wastes as opening material and fuel in lightweight bricks, chemically bonded laterite and a clay-tannery sludge brick/block.

Discussions

Several delegates were keen to know whether the processes described have been made commercially applicable. However, there was no positive response to these questions, and perhaps the work still continues to be at the level of laboratory curiosity.

Paper 4 Ecologically Sustainable Composite Materials for Low Energy City Vehicles

Presentation by Professor Alan Crosky

Professor Alan Crosky presented the paper describing ecologically sustainable composite materials for use in low energy city vehicles. Basically the data included relating to the vegetable fibre reinforced plastic composites. Tensile properties of large number of vegetable fibres were quoted, alongwith those of Carbon, Aramid and E-glass. Structure of natural fibres were briefly described, and the use of thermoplastic and thermosetting plastics in the preparation of the composites were also presented. The authors considered that thermoplastic bonded natural fibre reinforced composites possessed high specific strength and toughness and with suitable surface treatment could easily replace glass fibre reinforced composites.

Paper 5 Institutional Arrangements for Utilisation of Waste-based Building Technologies in Uganda

Mr. Wambuzi Ivan could not participate in the conference. In his paper, however, he had divided his presentation in four major sections (i) Technology Generation (ii) Technology Development, (iii) Technology Transfer and (iv) Technology Utilisation. These four routes were described as the main issue tackled by the Uganda National Council for Science and Technology, under the Ministry of Finance, Planning and Economic Development which is also responsible for Technology Policy Management in the country. In Uganda, the development of waste-technologies have so far not been paid adequate attention, the author says. The institutional development on waste based

technologies and the work of the Research Institutions were also described in details. The country is said to marching ahead in this area in indigenous technologies, R&D (particularly on utilisation of slags, stabilised bricks and limestone waste and rice husk binders) and also on standardisation of new materials and technologies through the Uganda National Bureau of Standards. The National Environment Action Plan 1991 takes care of general pollution problems in handing and utilisation of various wastes. In addition a number of voluntary organisation, institutions of learning and private sector companies are also said to be keen in the development of waste and byproducts related building materials and construction practices. Uganda has been also continuing as a member of the Network of African countries on Local Building Materials and Technologies established by the United Nations Centre for Human Settlements (Habitat) and the Commonwealth Science Council.

Paper 6 Indicative to Design Building Materials from Recycled and Natural Products of Mozambique

Ms Maria Joao Nazarath and her co-author could not participate in the conference. The authors have summaried a good review of the natural resources and the capacity and intention to develop them mainly for human resources, rural local resources, urban local resources and opportunities for employment. In this context they describe the valuable resources from river basins, Coastal low lands, dry and semi-arid pleatue and highlands. They mention the availability of asbestos, basalt, calcareous materials, ceramic and bauxite clay, gypsum, marble, perlite, red clay and also rice husk, thatch, palmtree residues, bamboo and wood. The authors showed keen interests in the exploitation of the above mentioned natural resources and their wastes and tailings into low cost building materials. In the final conclusions the authors rightly link up the above types of development with generation of new employment.

Paper 7 Normally Cured, Site Produced, Flyash based "Cellular Light weight Concrete"

Presentation by Mr. G.B. Singh

Mr. G.B. Singh presented the technology of the manufacture of Cellular Lightweight Concrete Blocks (CLC) using flyash and a specially formulated foaming agent, which are being produced in India, mainly following the low investment - non-autoclaved (high pressure steam) technology. Shri Singh claimed that an Indian company known as Dual Fabs (Chennai) had been manufacturing the standard hollow concrete blocks for the last 10 years, using flyashes from various thermal power stations. With the support of the CSIR & DST and extensive encouragement from the Building Materials and Technology Promotion Council, the Dual Fabs have expanded their manufacturing lines considerably. A large number of advantages of CLC are claimed such as dimensional accuracy, lightweight, high thermal insulation, very good acoustical property, fire resistance and weather and moisture resistance. Applications are both for load bearing and non-load bearing masonry.

The paper also describes the salient features of their other products such as reinforced concrete door frames, flyash polymer red mud composite door shutter.

The paper does not include the basic technical data and properties or the success stories of the application of the products of company except that details could be obtained from Dual Fab (Chennai), BMTPC (New Delhi) and RRL (Bhopal). The presentation included a large number of slides showing construction practices with CLC.

Discussions

In response to questions & observations, the author explained:

i. that the Foaming Agent could be obtained from M/s Neopor Systems (GmbH) Germany

ii. that a 7 kg. grove cutting machine is applied, using one labour; Neopre Foaming Agent is to be imported and it is exempted from customs duty, and plastered CLC blocks are not costlier than plastered brick work.

Paper 8 The Rationale for Portland Pozzolana Cement Composition

Presentation by Shri N. Kalidas

Shri N. Kalidas presented his paper with advocating the use of Portland Pozzolana Cement. He mentioned that in high strength cement and/or high early strength cement, higher amount of tri-calcium silicate (C_3S) and high fineness contributed to liberation of very high amount of $Ca(OH)_2$, on hydration which were harmful to the overall durability of concrete. In his opinion, use of flyash like materials reduces the C_3S content and thereby lowers the $Ca(OH)_2$ to optimum level, with the result of regulated strength development lower, permeability and increased production of steel reinforcement from corrosion, and also maximum changes of abnormal drying shrinkage cracks.

Discussions

In the modern concrete technological practices, the controls of W/C ratio, mechanical consolidation, use of admixtures etc. take care of various aspects of rapid rate of strength development or those of high strength cements. Nevertheless, the trend is definitely to exploit to the maximum the inherent hydraulic constituents of the glassy phases of materials like ground granulated blast furnace slag, flyash and other pozzolanic materials to produce concrete, containing these additives as high as 60 per cent.

Dr. O.P. Rao supporting the programmes of utilisation of the wastes in concrete suggested formation of the CSIR (India) mission the subject "New Materials from Wastes and Byproducts". He also offered on behalf of the CSIR, transfer of the know how and technologies of the CSIR laboratories to other countries.

TECHNICAL SESSION IV-A *(Forenoon)*

Date : 15.4.1999
Time : 1200-1300 hrs.

EMERGING TECHNOLOGIES FOR BUILDING MATERIALS BASED ON BIO-MASS, BAMBOO, PLANTATION TIMBERS AND FIBRES AND OTHER LIGNOCELLULOSNIC WASTES.

Chairman : Mr. Jonah Ichoya, Zambia
Co-Chairman : Professor Alan Crosky, New Zealand
Rapporteur : Dr. V.T.L. Bogahawatta, Sri Lanka

Paper presented:

Sr. No	Speakers	Country	Title of the Paper
1	Jonah Ichoya	Zambia	Housing Problems in Sub-Saharan Africa : The case for Waste and By-products Resources for Building Materials
2	E.T.N. Bisanda	Tanzania	Indigenous Materials from Agricultural Wastes for the Tropical Regions of Africa
3	Joel K. Kateregga	Uganda	Promoting Bamboo as a Potential Building Material for Low Income Housing
4	Arun K. Bansal, S.S. Zoolagud	India	Plantation Wood, Bamboo and Lignocellulosics - As Future Source for Building Materials

Paper 1 Housing Problems in Sub-Saharan Africa : The case for Waste and By-products Resources for Building Materials

Presentation by Mr. Jonah Ichoya

Mr. Jonah Ichoya reviewed the housing problems in sub-Saharan Africa, particularly in COMESA countries. Quoting reports of the World Bank (1988), Urban Perspective Vol. 2 No 3 (1992), COMESA (1999) and of United Nations World Population Prospects (1988) the author presented the data on Urbanisation and Informal Sector Construction of the African countries of Botswana, Angola, Egypt, Ethiopia, Morocco, Kenya, Rwanda, Senegal, Tanzania, Tunisia, Sudan, Zambia and Zimbabwe, and also of Mozambique, Malawi, Lesotho, Swaziland etc. He also presented the housing needs of Kenya, Malawi, Uganda and Zambia. Further he compared the urbanisation growth of N. America, Europe, Russia, Africa and Asia.

The paper emphasised the need for alternative technologies in COMESA countries.

Paper 2 Indigenous Materials from Agricultural Wastes for the Tropical Regions of Africa

Presentation by Dr. E.T.N. Bisanda

Dr. E.T.N. Bisanda in his paper highlighted the availability of large quantities of agricultural waste materials in Tanzania in particular, and other tropical regions of Africa. The author gave an account of the evaluation and characterisation data on the agro-wastes available in Tanzania and the results of the tannin-CNSL resin bonded agro-fibre composite materials, particularly utilising rice husk, coir and coir dust, bagasse, sisal pulp and saw dust. The author further presented a large number of data on the comparative mechanical properties of the samples of composites, particle boards, and other fibre reinforced materials using various resins such as polyester, epoxy, CNSL etc.

Dr. Bisanda further suggested cooperation between African countries and India in the R&D and technology transfer in the area of composites.

Paper 3 Promoting Bamboo as a Potential Building Material for Low Income Housing

Presentation by Mr. Joel K. Kateregga

Mr. Joel K. Kateregga presented his paper advocating the excellent properties of bamboo for use in low income housing. A case study on the use of bamboo in Casto-Rico was presented and use of bamboo as a roofing material was stressed. He desired to have information from India on improving the quality of split-bamboo in corrugated roofing systems. He further explained the drawbacks in method of improving quality of bamboo advantages and disadvantages and on the limited life of bamboo.

Paper 4 Plantation Wood, Bamboo and Lignocellulosics - As Future Source for Building Materials

Presentation by Mr. Arun K. Bansal

Mr. Arun K. Bansal presented his paper advocating the extensive utilisation of plantation wood, bamboo and other lignocellulosic materials as the future source of building materials in India and elsewhere. The speaker explained about the work done in his institute, Indian Plywood Industries Research and Training Institute, Bangalore (India). In his paper, data are included on the potential availability of wood and nonwood fibres, energy requirements in their production, mechanical properties of a large number of wood and non-wood species. The authors have further incorporated details of experimental work (sponsored by BMTPC) on bamboo mat corrugated sheet, and rice husk particle board (being produced on industrial-scale) and on the methods of improving the durability of bamboo-fibre based composites.

TECHNICAL SESSION IV-B *(Afternoon)*

Date : 15.4.1999
Time : 1400-1500 hrs

Chairman	:	**K.G.Satyanarayana, SERC, India**
Co-Chairman	:	**Jonah Ichoya, Zambia**
Rapporteur	:	**V.T.L. Bogahawatta, Sri Lanka**

Paper Presented:

Sr. No	Speakers	Country	Title of the Paper
1	Maurice M. Chitondo	Zambia	Selection Criteria for Waste and By-products as Secondary Resources for Producing Composite Building Materials for Affordable Housing in Developing Countries
2	Albert Butare	Rwanda	Utilisation of Bio-digested Effluents from Cow Dung as a Raw Material for Rural Housing in Rwanda
3	W.Balu Tabaaro	Uganda	Potential Use of Waste and by-Products for the Production of Building Materials for Low Cost Housing in Uganda
4	Mohini Saxena, V.Sorna Gowri	India	Potentials of Utilisation of Industrial Wastes for Developing Wood Substitute

Paper 1 Selection Criteria for Waste and By-products as Secondary Resources for Producing Composite Building Materials for Affordable Housing in Developing Countries

Presentation by Mr. Maurice M. Chitondo

Mr. Maurice M. Chitondo in his paper mainly included the basis of the selection wastes and byproducts as secondary resources for making composites. He emphasised the need for extensive activities in various African countries and developing some criteria on the selection of appropriate technologies based on industrial and agricultural wastes and byproducts. The problems of high energy consumption and lack of standards were also highlighted.

Paper 2 Utilisation of Bio-digested Effluents from Cow Dung as a Raw Material for Rural Housing in Rwanda

Presentation by Mr. Albert Butare

Mr. Albert Butare presented his paper describing the use of soil and bio-effluent slurry for making small size roofing sheet. His paper also included the scope and direction of using wood and wood-based materials and soil combinations in housing in his country

and desired to know the improvements in technologies in the uses of mud and wood composites.

Discussions

Mr. Anil Kaul cautioned about the possible high energy content in the manufacture of such board and also about their brittleness.

Paper 3 Potential Use of Waste and by-Products for the Production of Building Materials for Low Cost Housing in Uganda

Presentation by Mr. W. Balu Tabaaro

Mr. W. Balu Tabaaro stressed the problems of increasing population in Uganda and enlarging gaps of demand and supply of housing for the masses. He pointed out that in view of large volumes of mineral wastes and agricultural residues available in his country there is definitely great potential of development of new and alternative construction materials based on the locally available wastes.

Paper 4 Potentials of Utilisation of Industrial Wastes for Developing Wood Substitute

Presentation by Dr. (Miss) Mohini Saxena

Dr. (Miss) Mohini Saxena presenting her paper touched upon the magnitude of the enormous quantities of wastes, such as flyash, red mud, marble slurry etc. She described the process of making wood-substitutes using these wastes materials as filler and a jute fibre net cloth as base and a polymer (polyester) as binder, by mixing the inorganic wastes and polymer, calendering of jute fibre cloth, casting at 0.5 MPa pressure for 1 hr at room temperature. The sheet formed is demoulded and further cured at 80°C for 24 hr.

The composites as prepared by the above process are standardised for tensile strength (20-25 MPa), flexural strength (92-103 MPa), outdoor weather evaluation in an Atlas Wheatermeter and also that it conforms to certain microstructural properties for interfacial bonding. The product can be compared with medium density fibre (MDF) board, rice husk particle board and also teak wood, for various applications in buildings.

SOME SELECT PHOTOGRAPHS

INAUGURAL FUNCTION

INTERNATIONAL CONFERENCE ON "WASTE BASED CONSTRUCTION MATERIALS & TECHNOLOGIES"

Inauguration of the International Conference on "Waste and byproducts as Secondary Resources for Alternate Building Materials". Seen in the picture from left are Mr. Prem Behl MD EI, Mr. W.S. Nanayakara, Country Representative UNIDO India, Mr. Bandaru Dattatraya Hon'ble Minster of State for Urban Development, Mr. Suresh Prabhu, Hon. Minister for Environment and Forests, Mr. Micheal Kafabusa Werikhe, Hon'ble Minister of State for Housing & Communications, Government of Uganda, Mr. Z. Hasan, Secretary Ministry of Water Resources and Mr. T.N. Gupta, Executive Director BMTPC.

Mr. T.N. Gupta ED BMTPC presenting the welcome address

Mr. Suresh Prabhu Hon. Minister for Environment and Forests, Govt. of India lighting the ceremonial lamp. Also seen in the picture are Mr. Bandaru Dattatraya, Hon'ble Minister of State for Urban Development on his right.

Another view of the Inaugural Ceremony

Another close view of the lighting of the Ceremonial Lamp by the Hon. Ministers

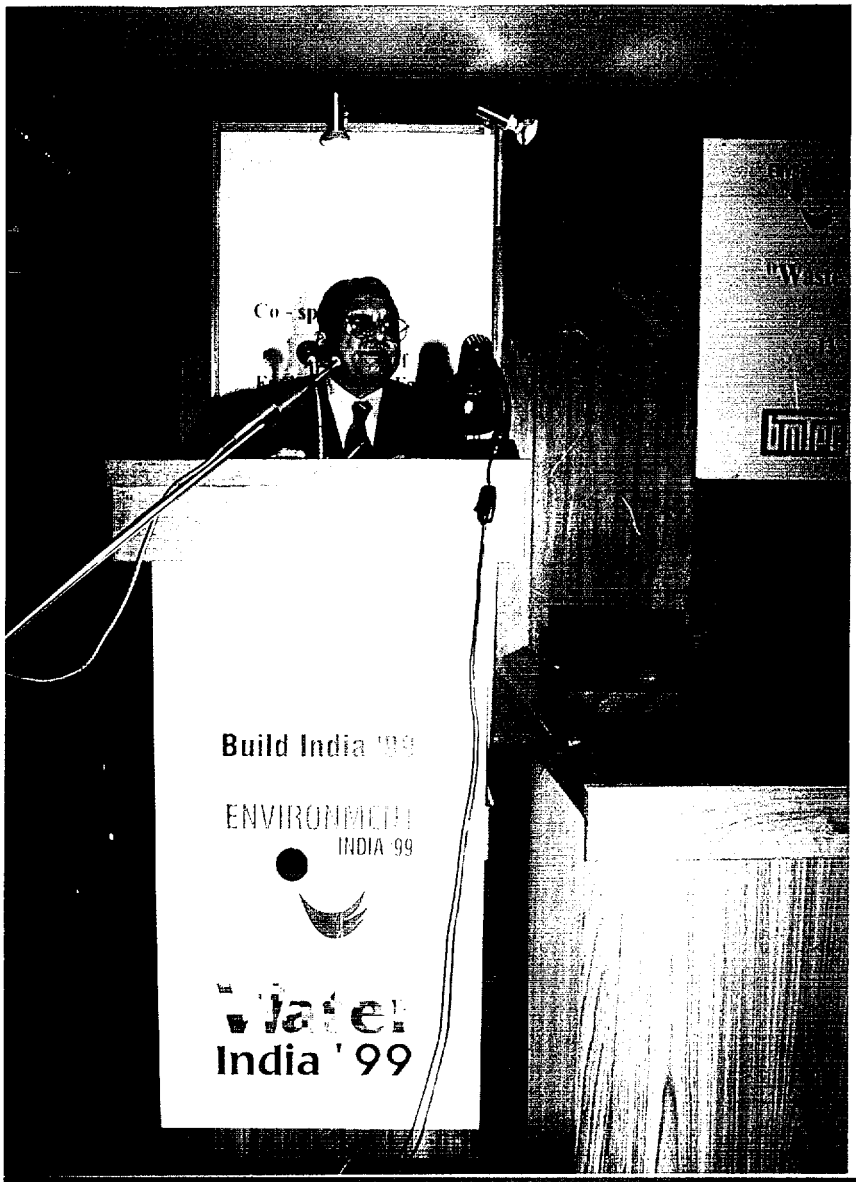
Mr. W.S. Nanayakara, Country Representative UNIDO India, is lighting the ceremonial lamp. Also seen in the picture are Mr. Bandaru Dattatraya, Hon'ble Minster of State for Urban Development, Govt. of India, and Mr. Suresh Prabhu, Hon. Minister for Environment and Forests, Govt. of India .

Mr. Bandaru Dattatraya, Hon'ble Minster of State for Urban Development lighting the ceremonial lamp

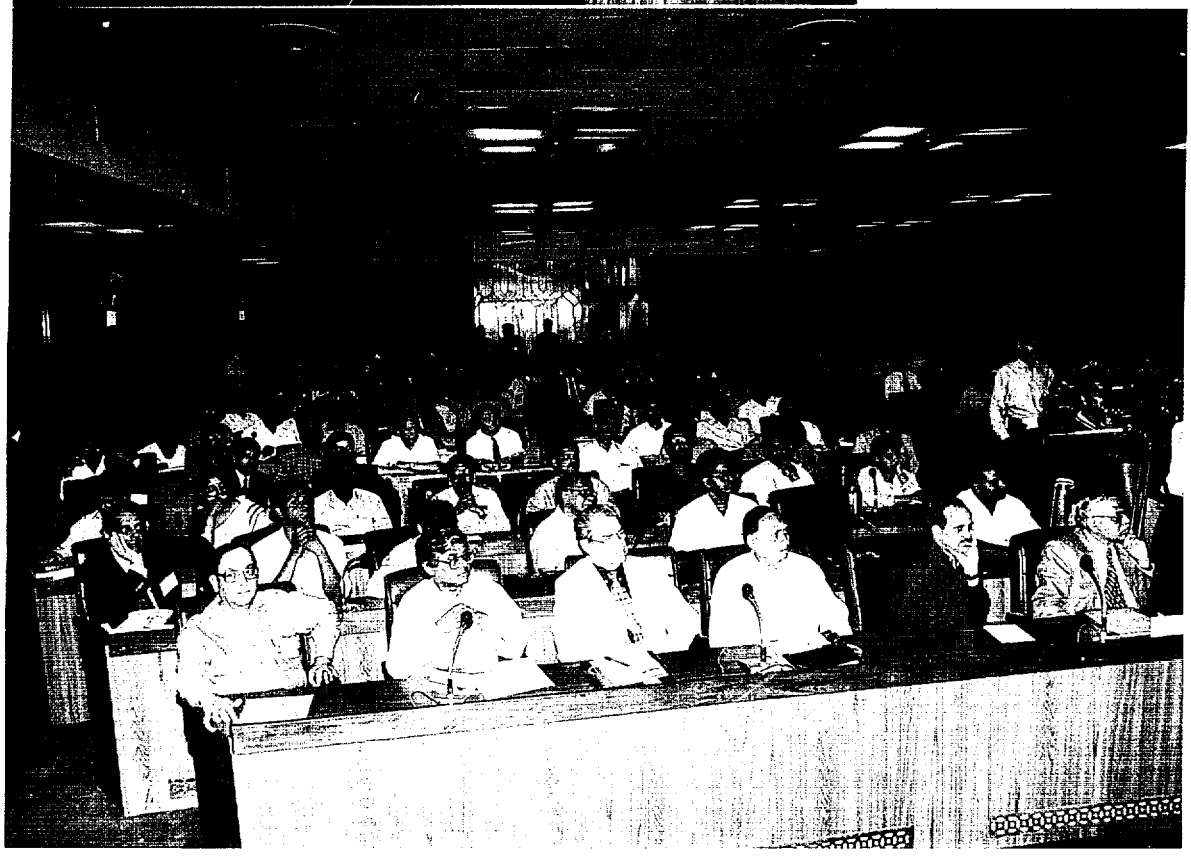
Mr. Micheal Kafabusa Werikhe, Hon'ble Minister of State for Housing & Communications, Government of Uganda *lighting the ceremonial lamp*

Mr. W.S. Nanayakara, Country Representative UNIDO addressing the conference on the role of UNIDO

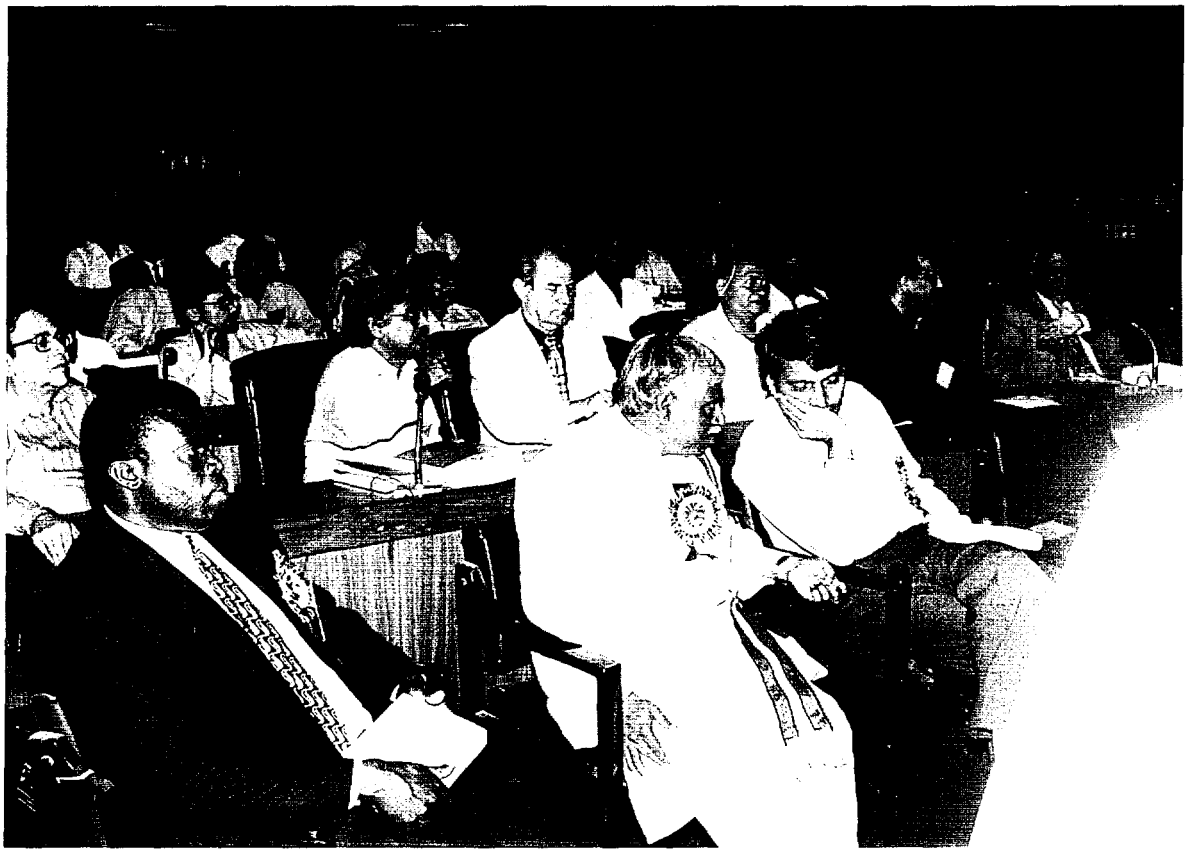
Mr. Suresh Prabhu, Minister for Environment and Forests addressing the delegate.



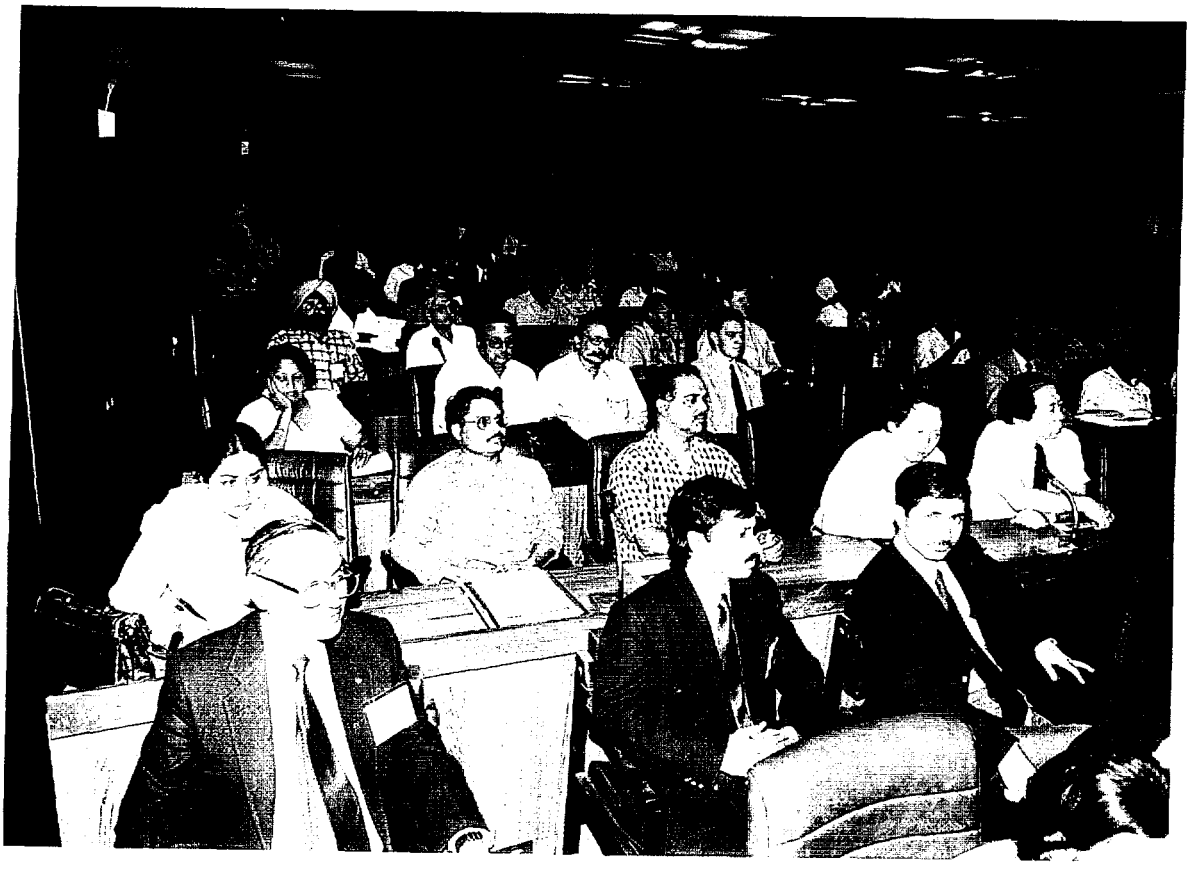
Mr. T.N. Gupta
ED BMTPC
addressing the
delegates



A view of the delegates

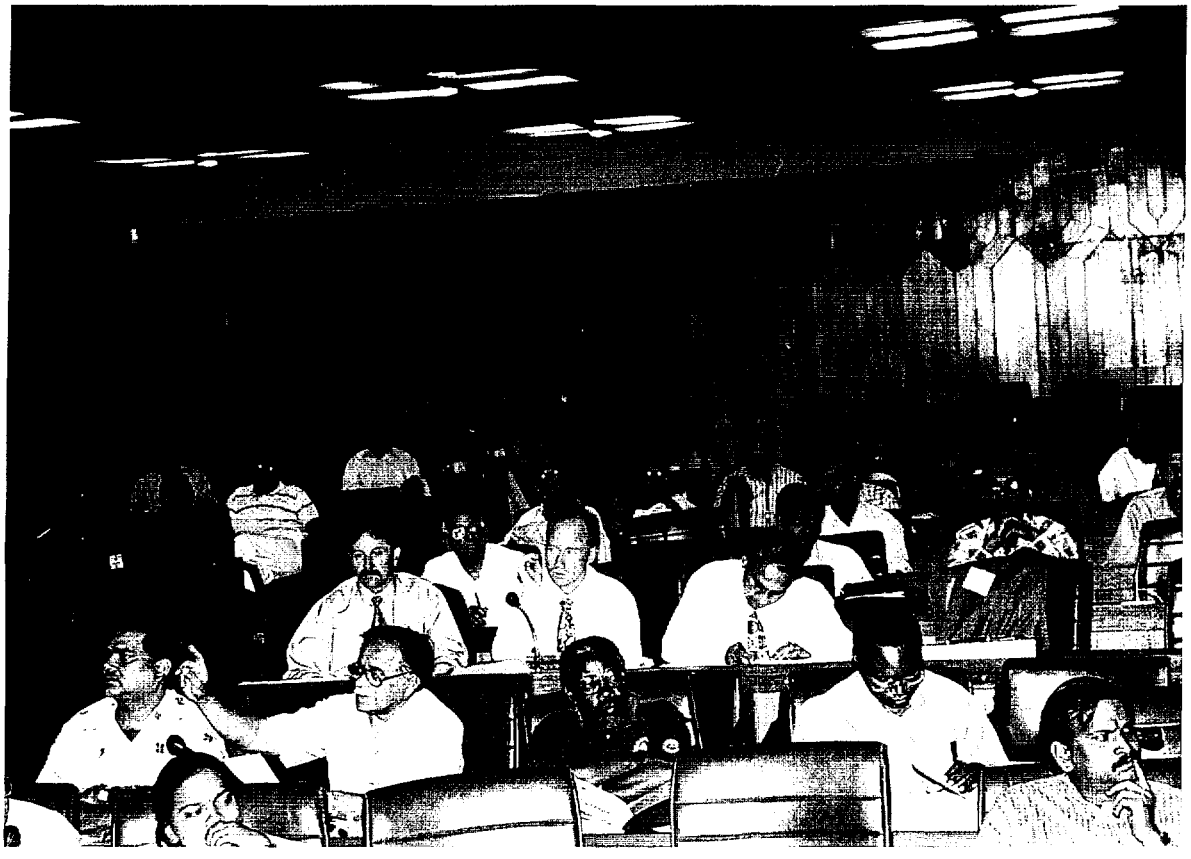


Delegates including the Mr. Bandaru Dattatraya Hon'ble Minster of State for Urban Development, Mr. Suresh Prabhu, Hon. Minister for Environment and Forests, Mr. Micheal Kafabusa Werikhe, Hon'ble Minister of State for Housing & Communications, Government of Uganda, viewing the awarding winning films



Delegates viewing the award winning films

Another view of the delegates participated in the conference



A view of the delegates attending the conference

Group photographs of the international delegates alongwith the senior officers from BMTPC. Seen in the picture from left to right are Mr. R.K. Celly BMTPC-*India*, Dr. N.B.M. Ranatunge-*Sri Lanka*, Mr. Maurice M. Chitondo-*Zambia*, Dr. W. Balu Tabaaro-*Uganda*, Prof. Alan Crosky-*Australia*, Mr. T.N. Gupta BMTPC-*India*, Dr. Martyn Bowis-*New Zealand*, Dr. Debes Bhattacharyya-*New Zealand*, Professor K.G. Satyanarayana RRL-*India*, S.K. Gupta BMTPC-*India*, Dr. Mohan Rai Formerly CBRI-*India*, Dr. Amit Rai BMTPC-*India*, Mr. Ariel Paggi-*Italy*, Dr. E.T.N. Bisanda-*Tanzania*

Mr. W.S. Nanayakara, Country Representative UNIDO receiving the memento from Mr. T.N. Gupta ED BMTPC

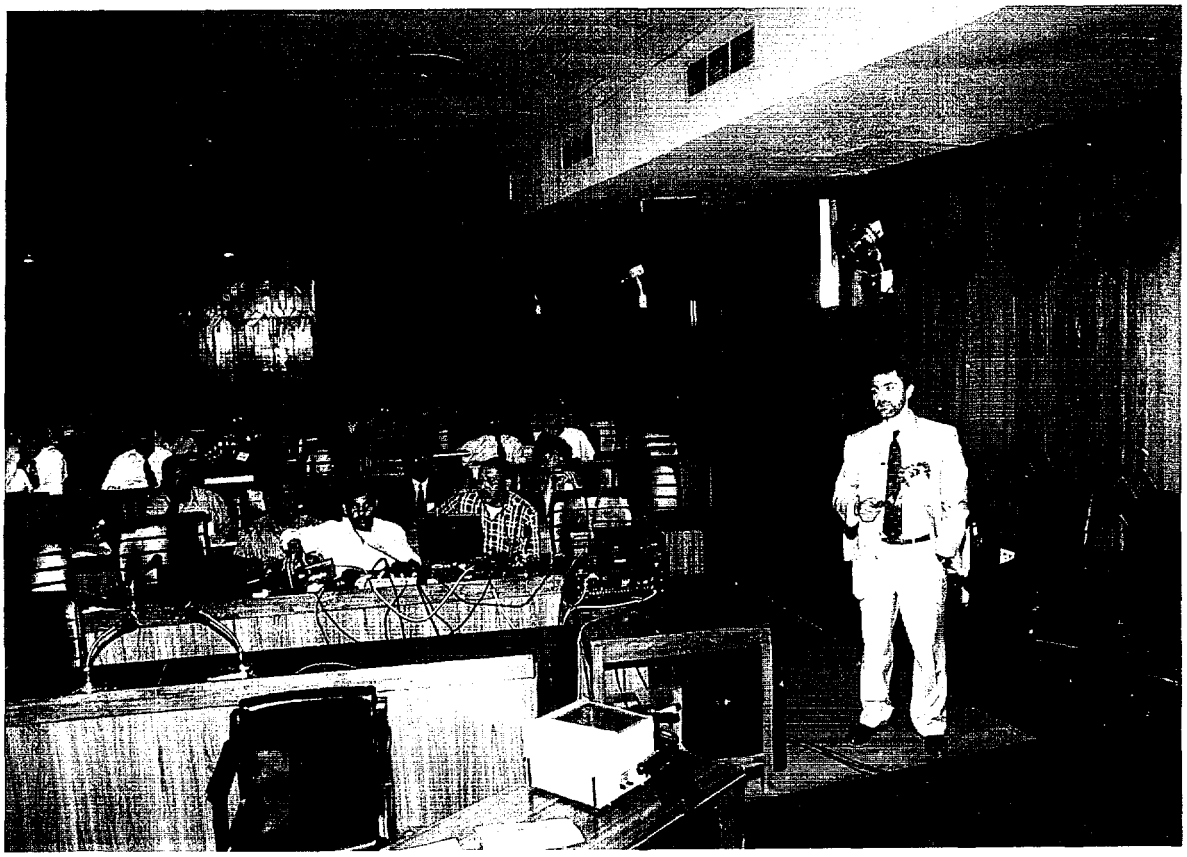
Mr. Z. Hasan Secretary Ministry of Water Resources presenting the award for the Best Film on Corporate Excellence for Environment

TECHNICAL SESSIONS

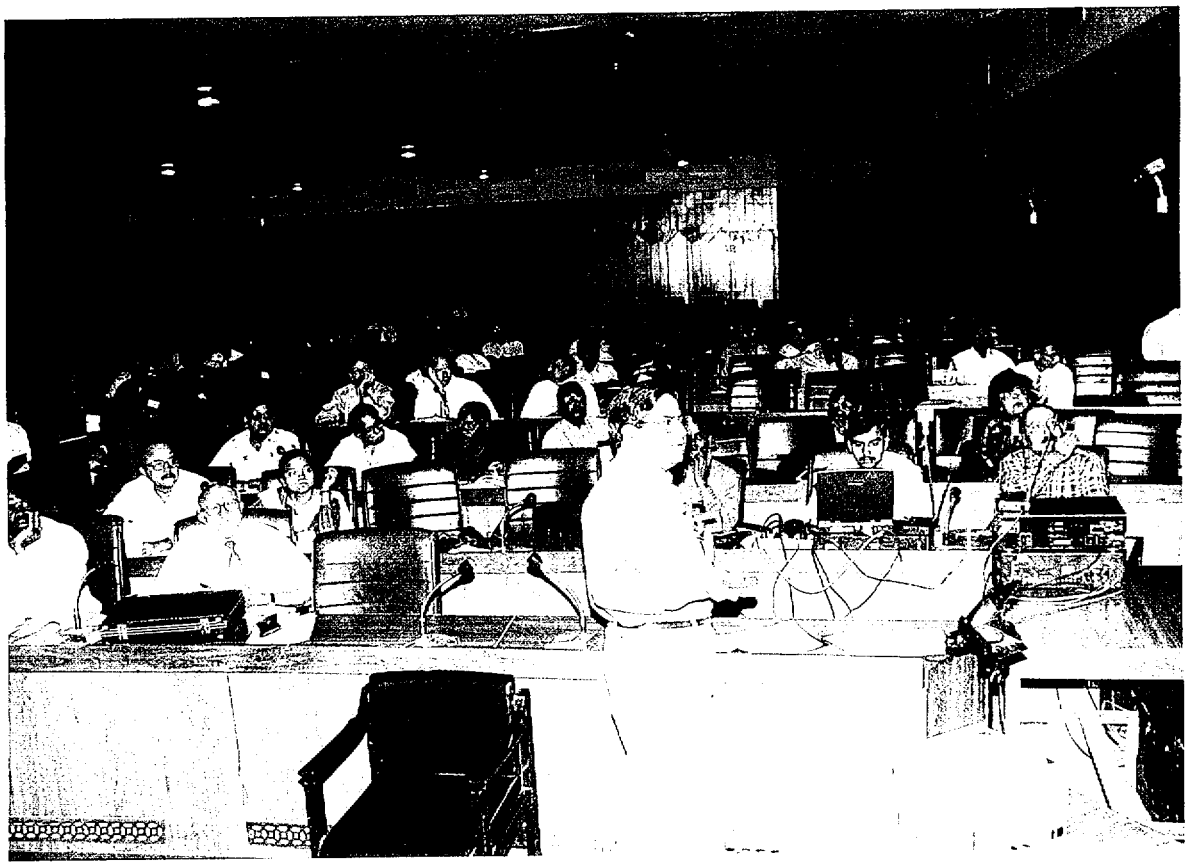
Technical Session in Progress. From left to right are Prof. Giorgio Bressi Italy, Mr. V. Suresh CMD HUDCO, and Dr. Mohini Saxena Scientist RRL Bhopal.

Mr Raffaele Moz from italy presenting his technical paper

Ms Sarah Ibanda Commissioner Ministry of Land, Govt. of Uganda presenting her technical paper



Prof. Giorgio Bressi from Italy presenting his technical paper

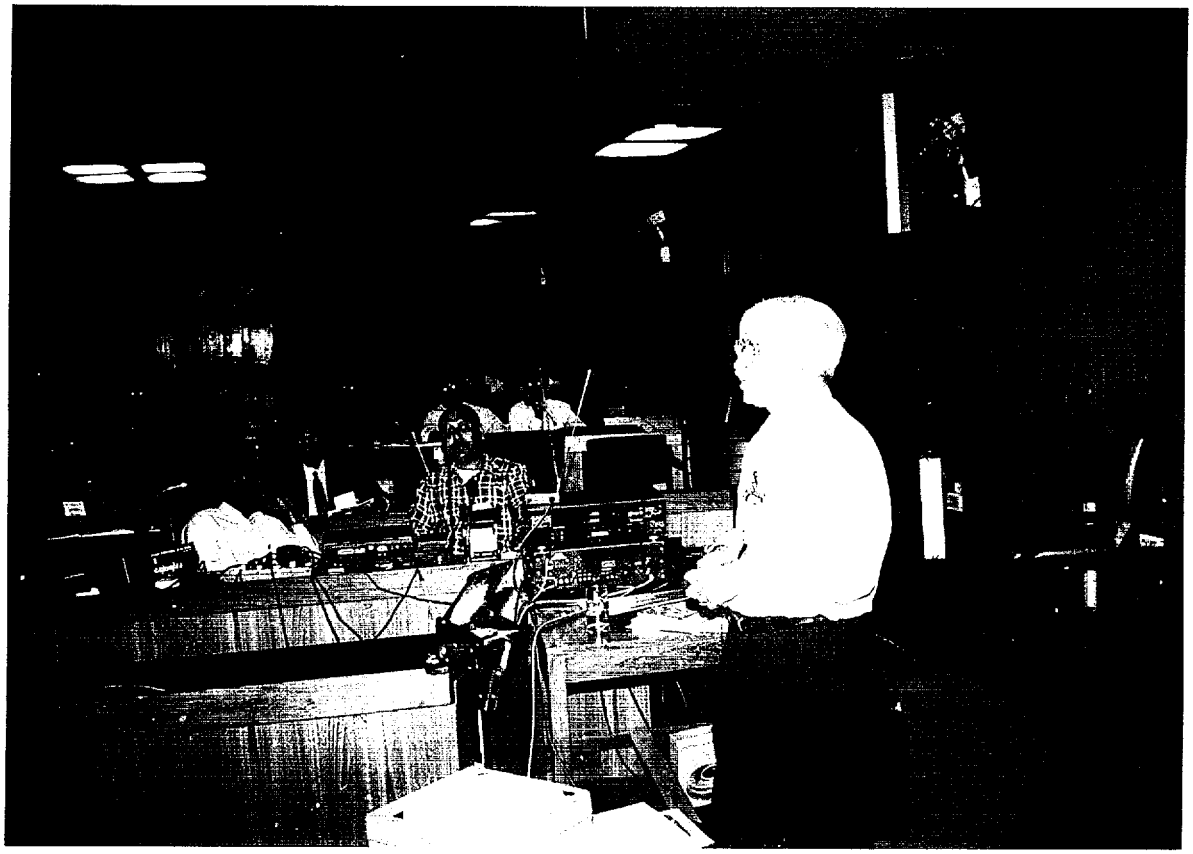


Dr. Vimal Kumar Director TIFAC presenting his technical paper

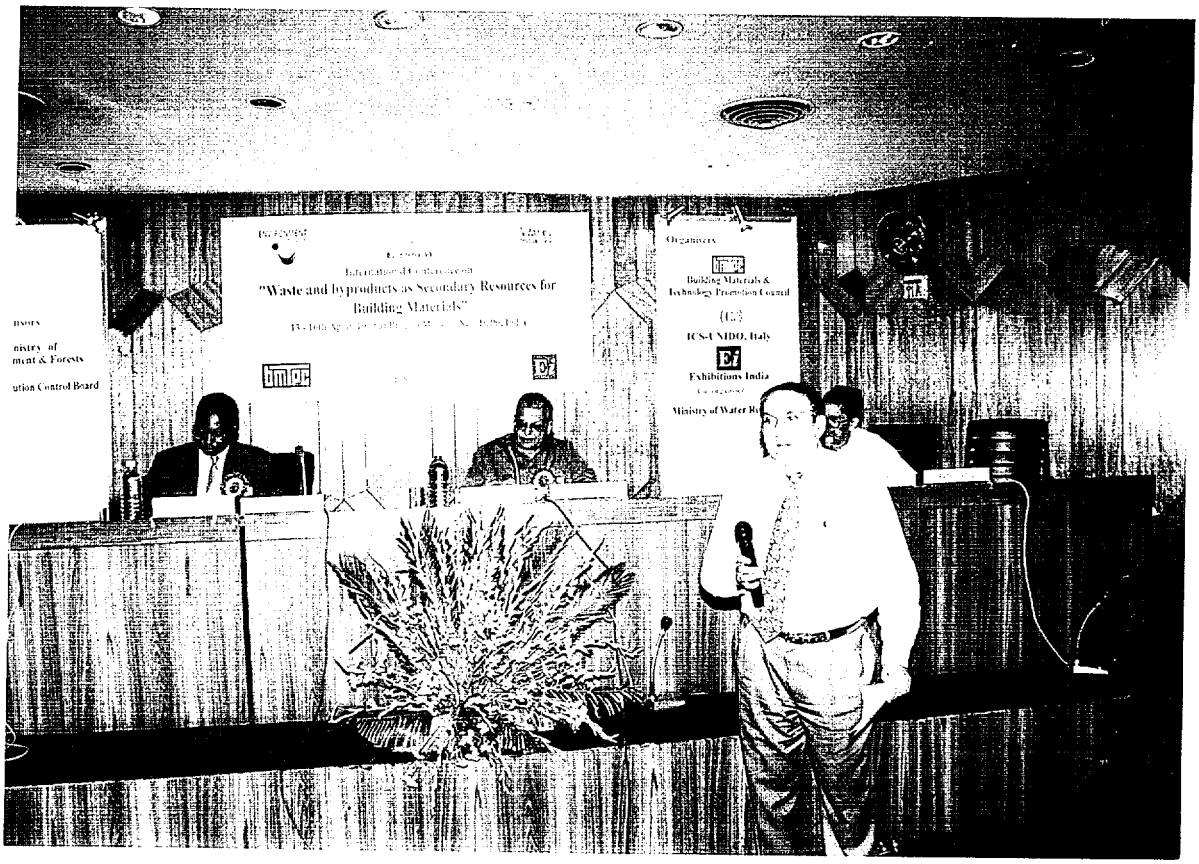
Mr. Arif Humayun from USA presenting his technical paper

Technical Session in progress. Seen in the picture are Dr. Debes Bhattacharyya New Zealand, Prof. K.G. Satyanarayana RRL Trivendrum and Mr. J. Sengupta Chief - BMTPC.

Mr. Ariel Paggi from Italy presenting his technical paper

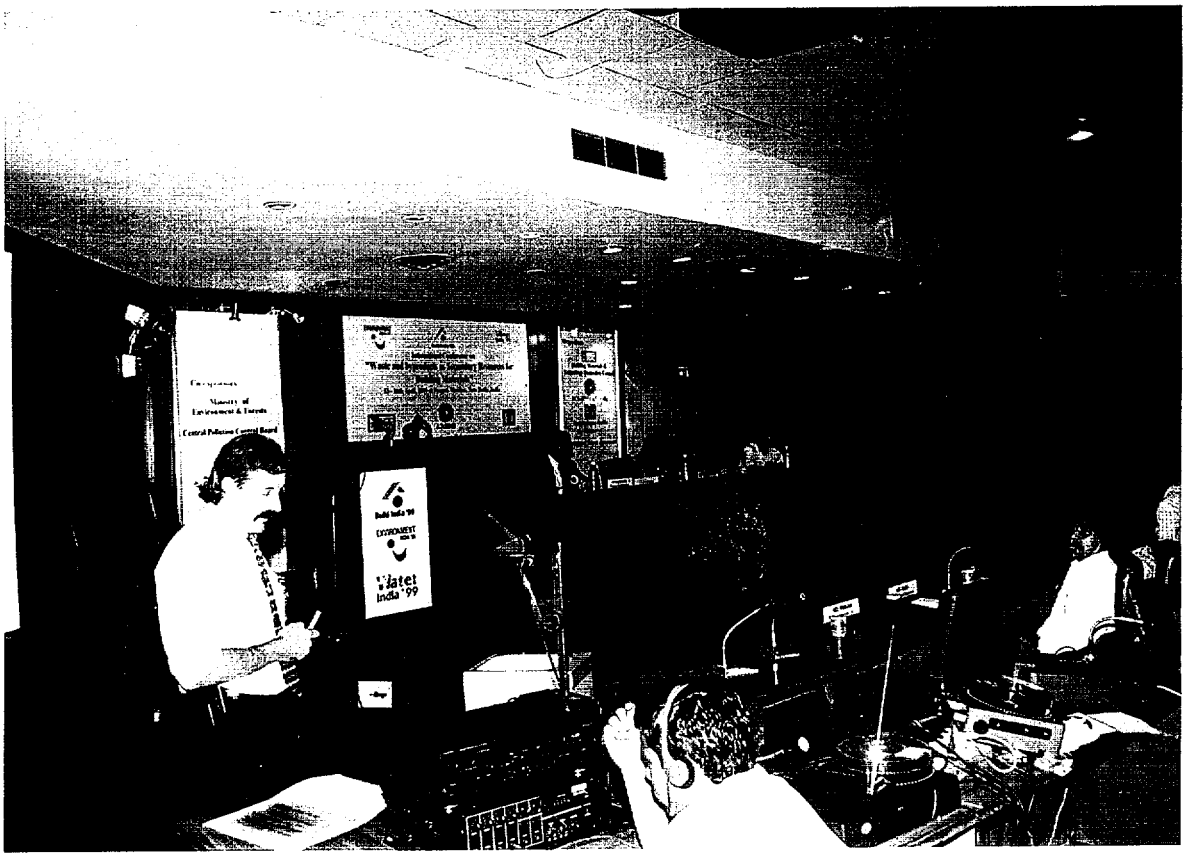


Mr. O.P. Ratra formerly Dy Chief BMTPC presenting his technical paper



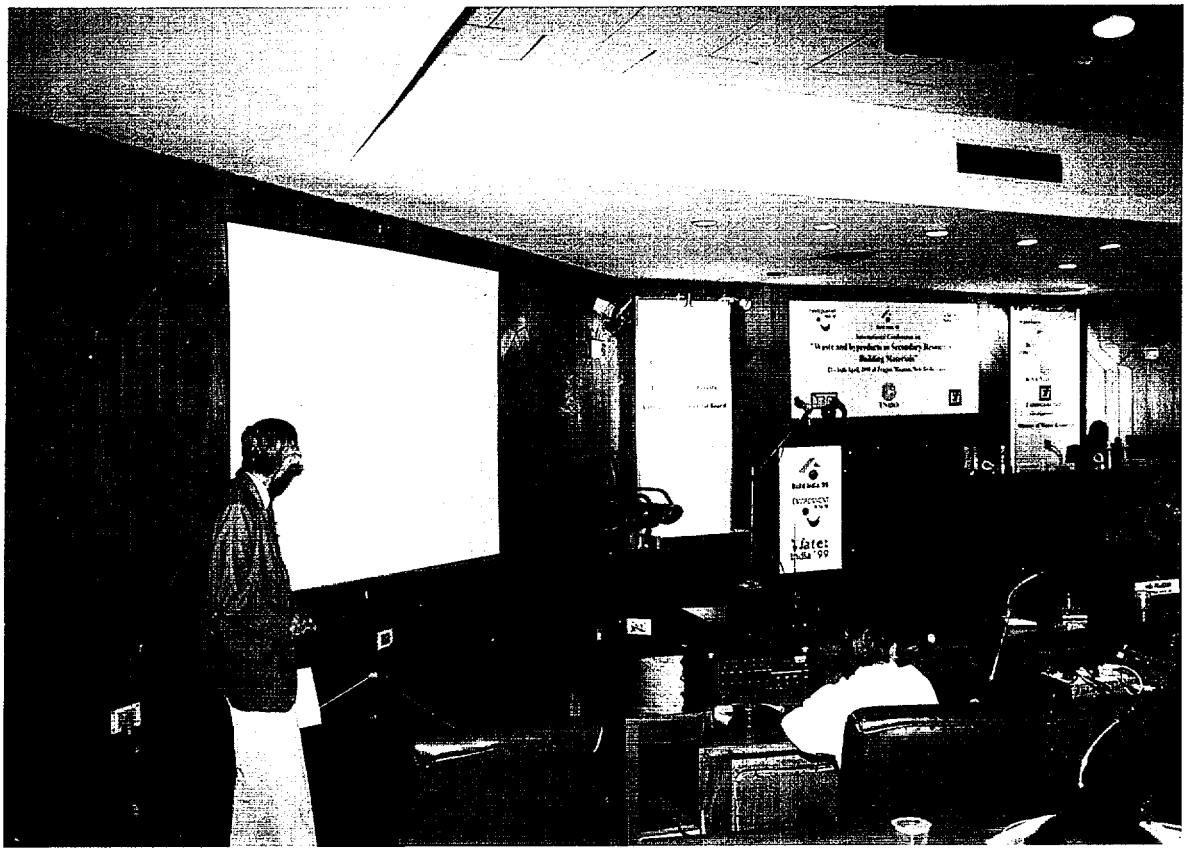
Dr. Debes Bhattacharyya from New Zealand presenting his technical paper

Prof. K.G. Satyanarayana RRL Trivendrum presenting his technical paper

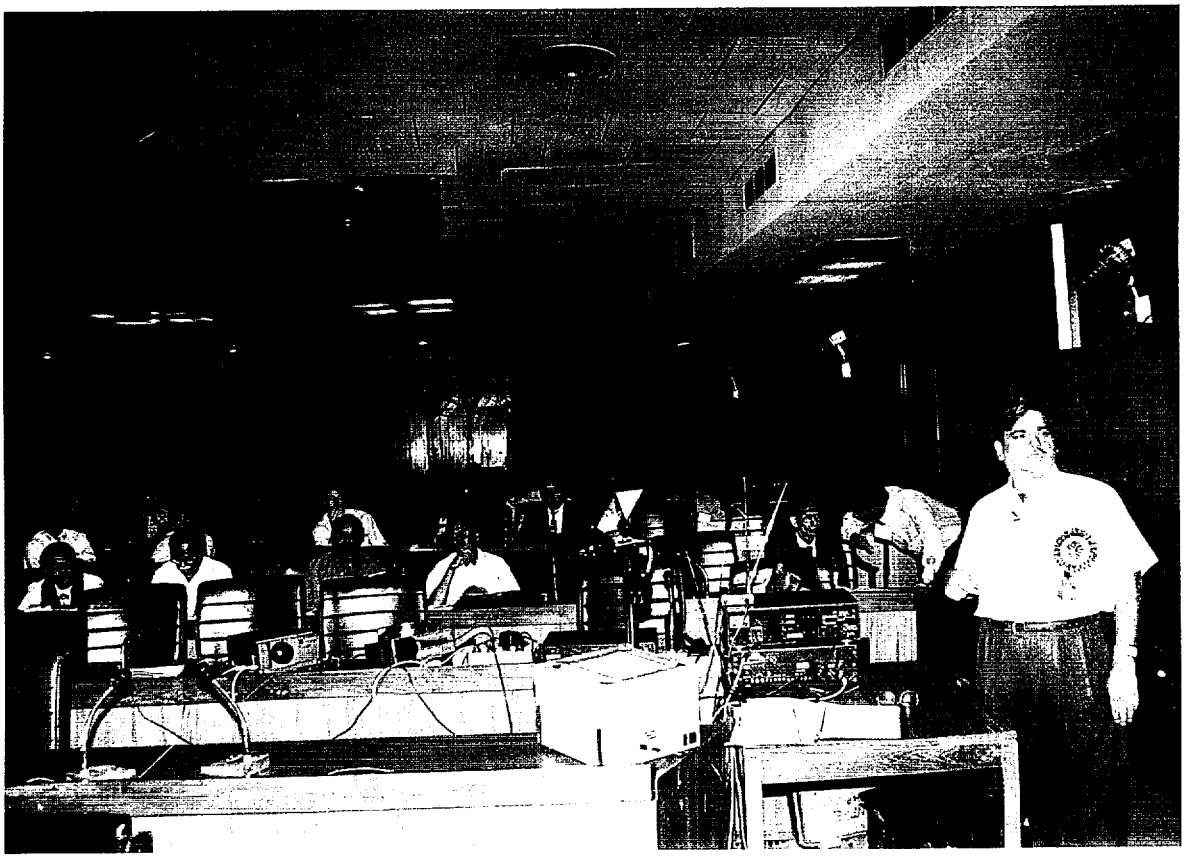


Prof. Alan Crosky from Australia presenting his technical paper

Mr. G.B. Singh Consultant System Technologist presenting his technical paper

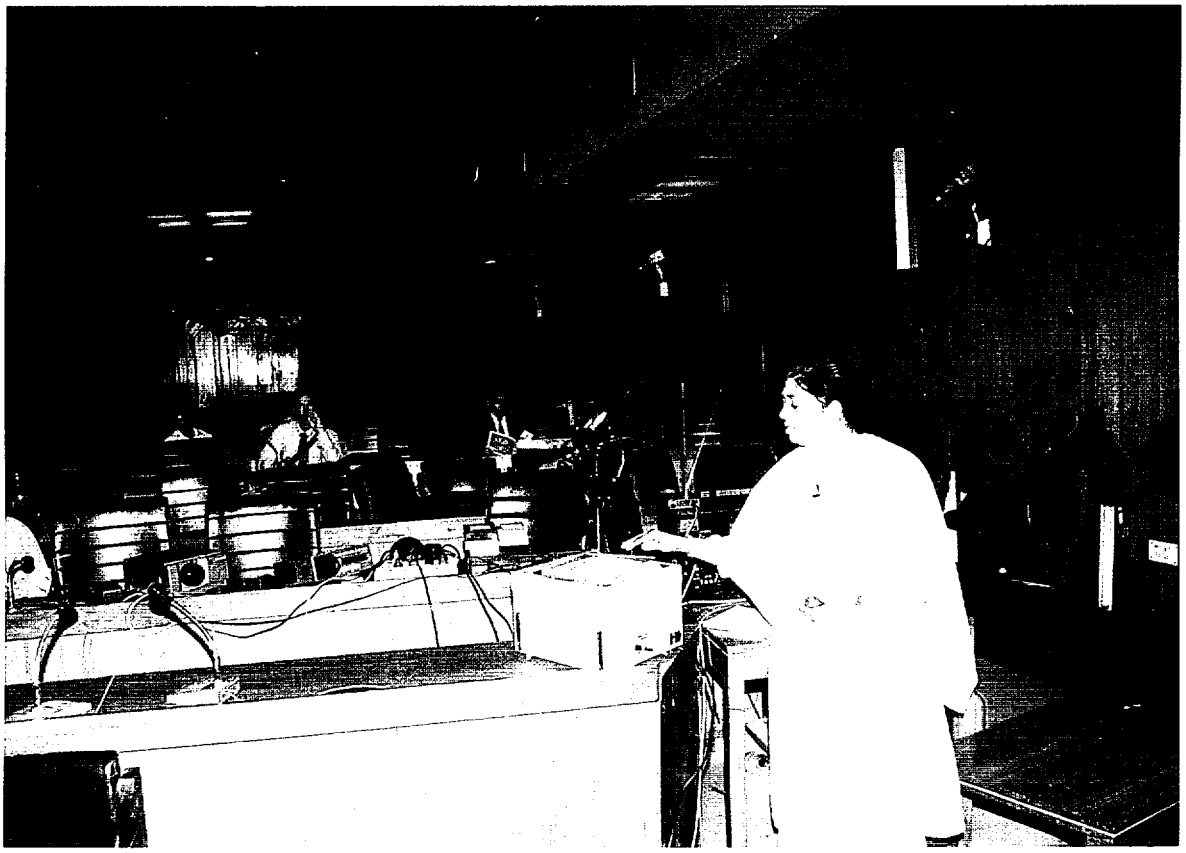


Dr. N.B.M. Ranatunge from Sri Lanka presenting his technical paper



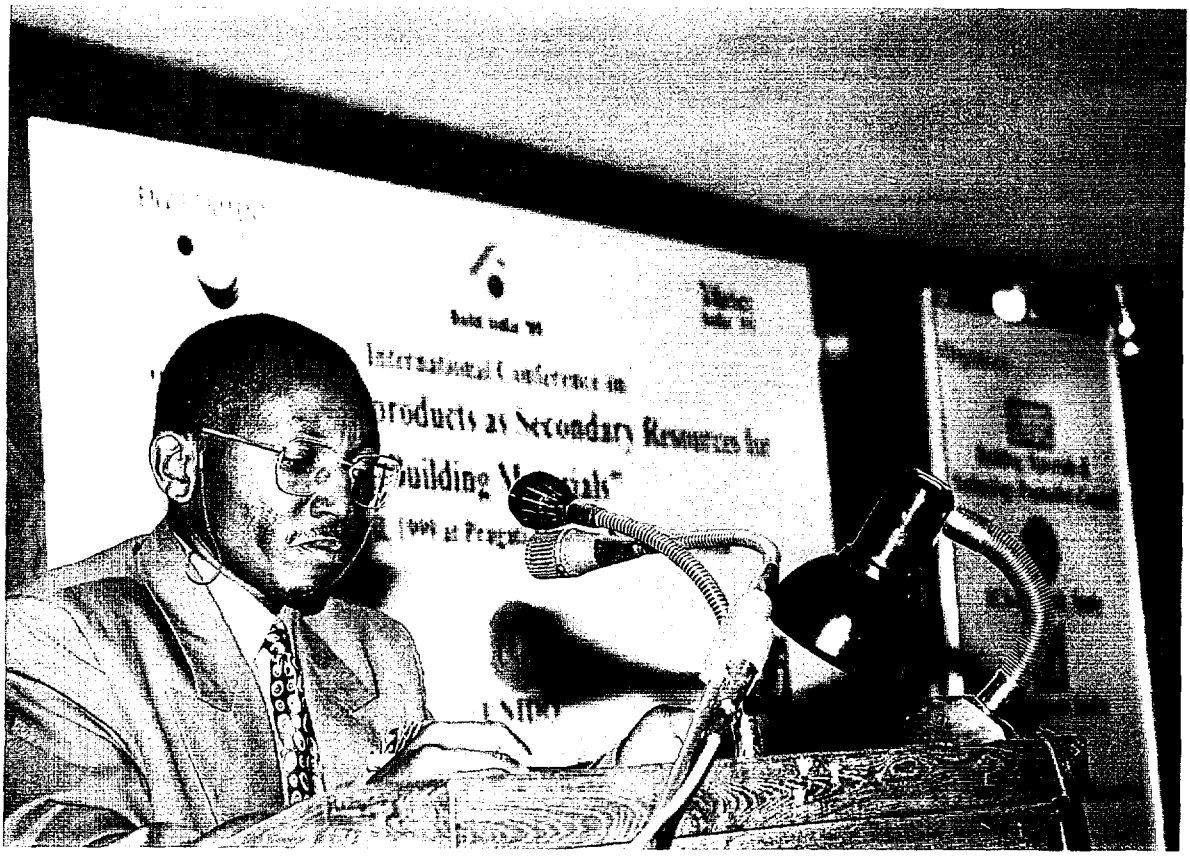
Dr. A.K. Bansal from IPIRTI Bangalore presenting his technical paper

Mr. T.N. Gupta ED BMTPC concluding the Technical Session



Dr. Mohini Saxena Scientist RRL Bhopal presenting her technical paper

Dr. E.T.N. Bisanda from Tanzania presenting his technical paper



Mr. Maurice M. Chitondo from Zambia presenting his technical paper

Eng. Albert Butare from Rwanda presenting his technical paper

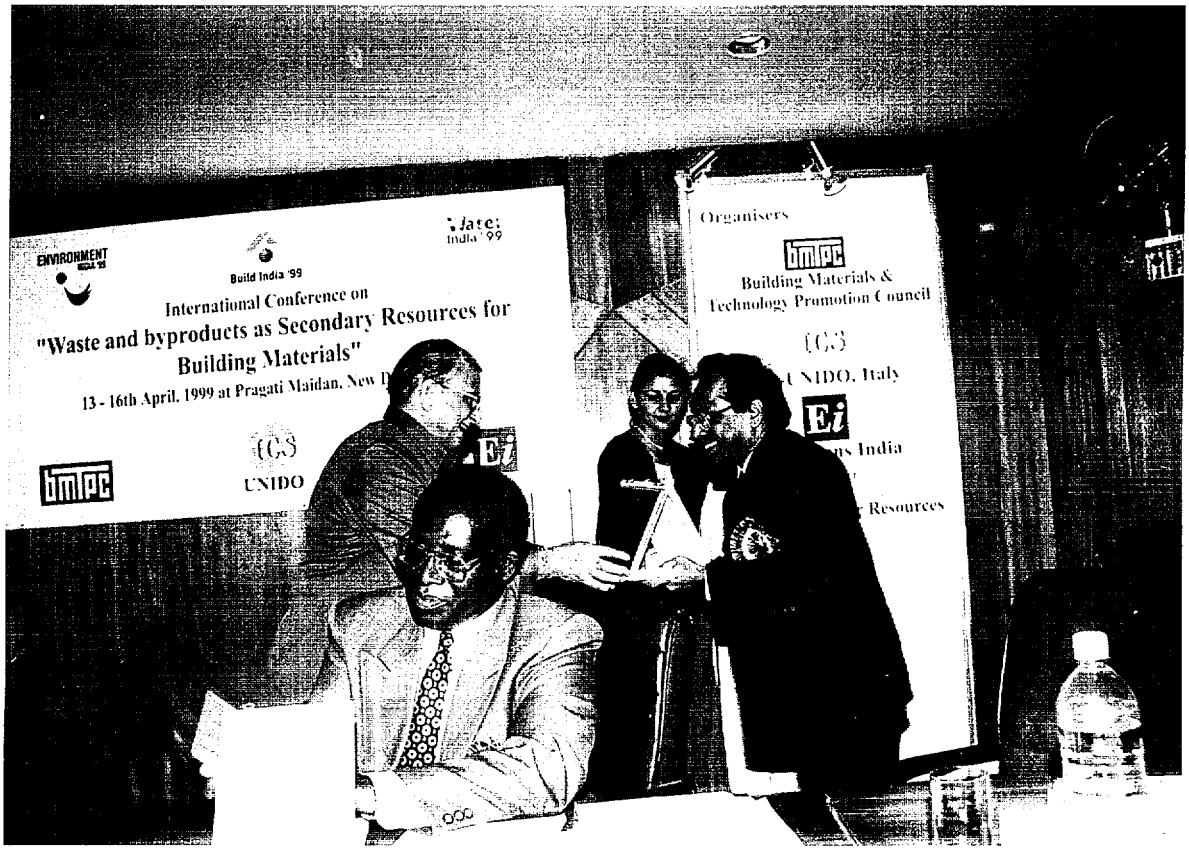
Mr. Arun Kumar from Development Alternatives presenting his technical paper

Mr. T.N. Gupta ED BMTPC presenting memento to Dr. Debes Bhattacharyya, New Zealand

Mr. V. Suresh CMD HUDCO receiving the memento from Mr. T.N. Gupta ED BMTPC

Prof. Alan Crosky receiving the memento from Mr. T.N. Gupta ED BMTPC

Professor Giorgio Bressi receiving the memento from Mr. T.N. Gupta ED BMTPC



Dr. VTL Bogahawatta receiving the memento from Mr. T.N. Gupta ED BMTPC. Also seen in the picture is Mr. Jonah Ichoya representing COMESA keenly going through some points.

RESOLUTIONS AND RECOMMENDATIONS

Mr. T.N. Gupta addressing the participants at the Valedictory Function.

Prof. Alan Crosky addressing the participants at the Valedictory function.

Prof. Alan Crosky addressing the participants at the Valedictory function.

EXHIBITION BUILD INDIA' 99

IMPORTANT VISITORS TO THE EXHIBITION

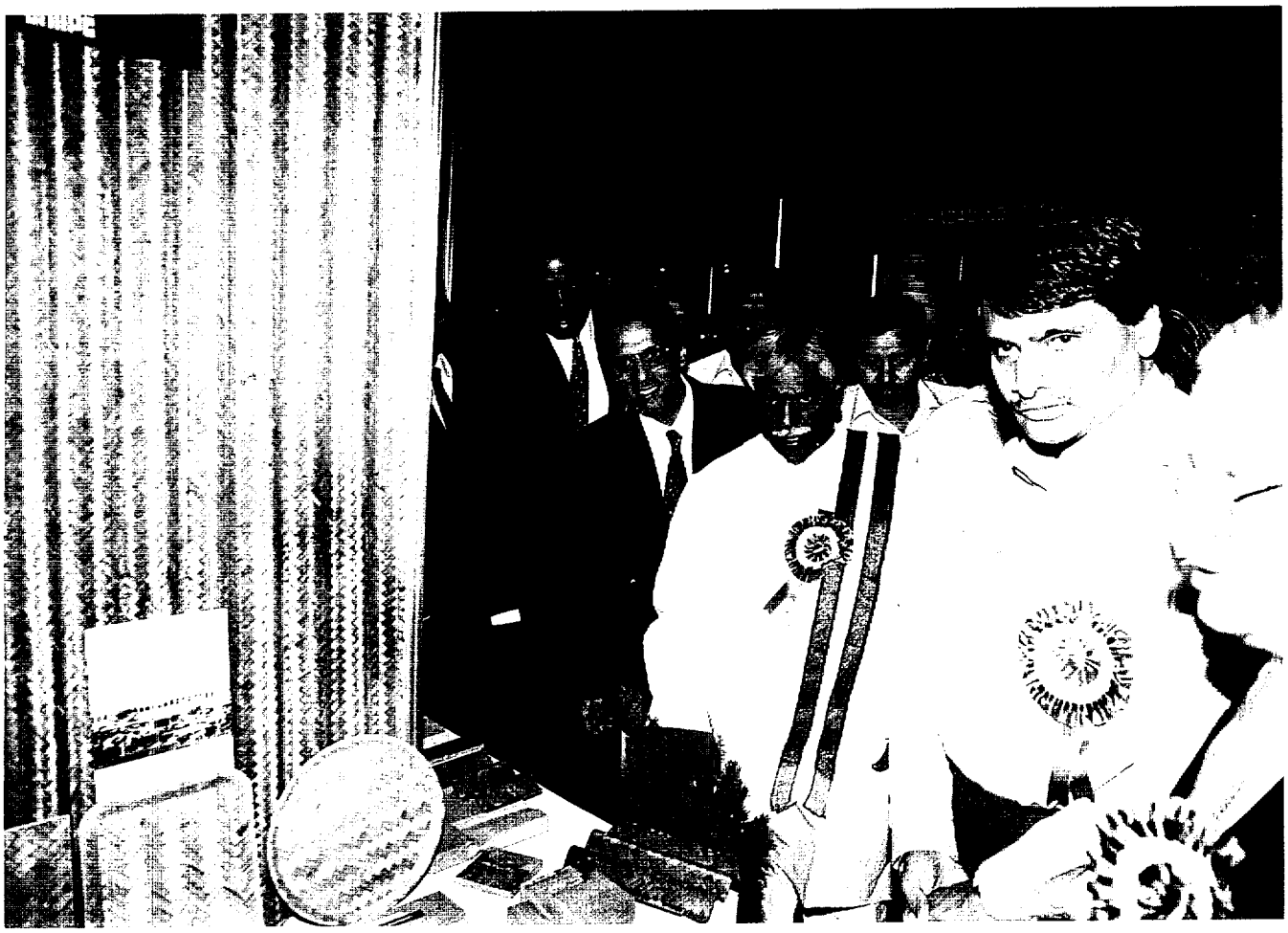
Mr. Suresh Prabhu, Hon. Minister for Environment and Forests cutting the inaugural ribbon for the exhibition Build India'99. Also seen in the picture are Mr. Bandaru Dattatraya Hon'ble Minster of State for Urban Development, Mr. Micheal Kafabusa Werikhe, Hon'ble Minister of State for Housing & Communications, Government of Uganda, Mr. V. Suresh CMD HUDCO

A view from the top on the Build India'99 Exhibition

Another view of the exhibition Build India'99

Mr. T.N. Gupta ED BMTPC showing some waste-based building products promoted by BMTPC to Mr. Suresh Prabhu, Hon. Minister for Environment and Forests. Also seen in the picture is Mr. V Suresh CMD HUDCO

Mr. Suresh Prabhu. Minister for Environment and Forests and Mr. Bandaru Dattatraya Hon'ble Minster of State for Urban Development taking interest in some of the innovative products with interest at BMTPC's stall



Unique products from Bamboo on display. The Hon'ble Ministers showing keen interest

Another view of the Hon'ble Ministers going through the exhibition

Another view of the Hon'ble Ministers going through the exhibition. while Mr. T.N. Gupta is explaining the innovative building products made from agro industrial wastes.

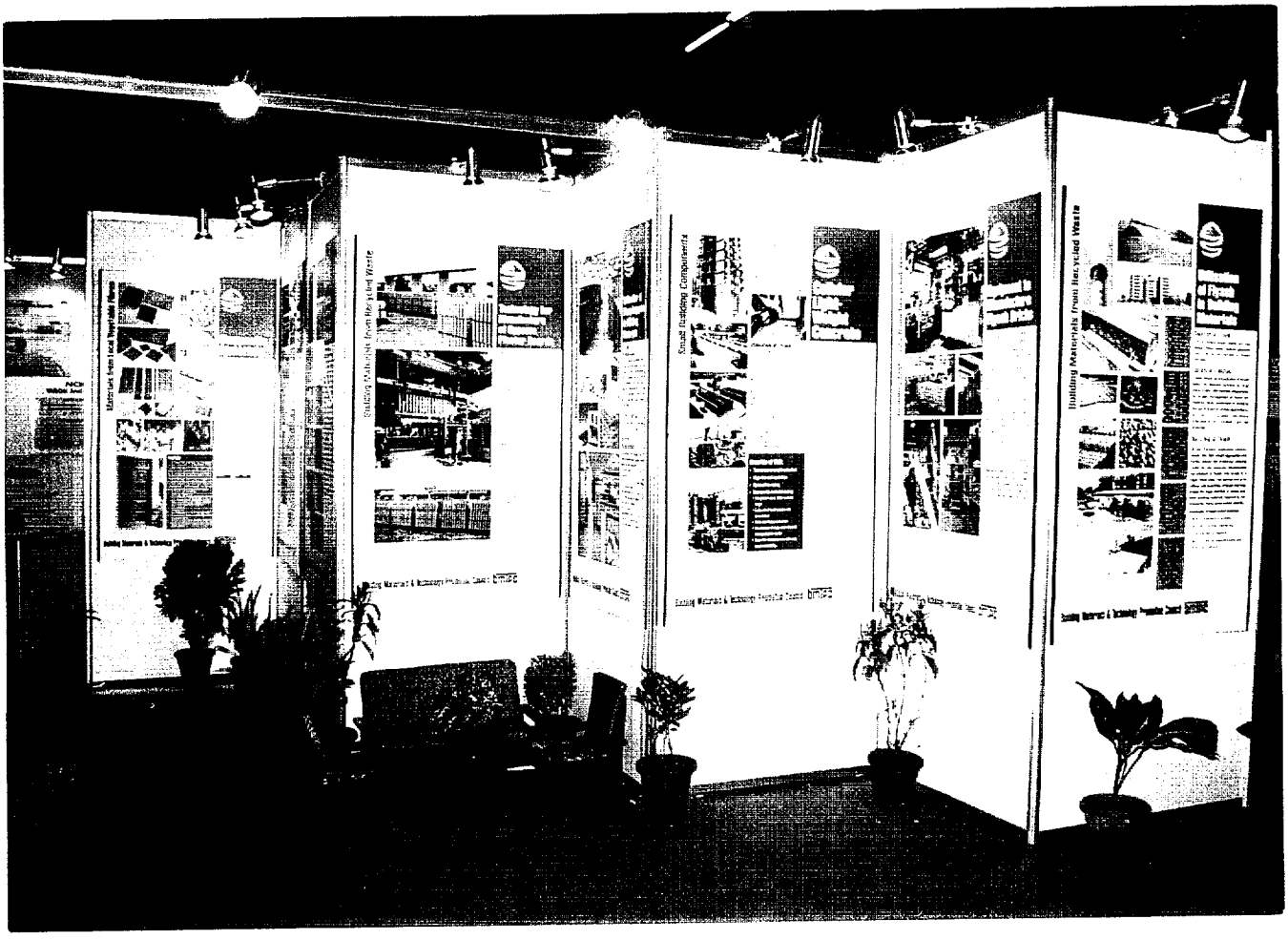
A lighter moment in the exhibition with High Commissioner of Uganda in India. Also seen in the picture are Ms. Sarah Ibanda from Uganda and Mr T.N. Gupta ED BMTPC.

Mr. T.N. Gupta ED BMTPC taking around Mr. Z. Hasan Secretary Ministry of Water Resources at BMTPC's display in the exhibition Build India'99.

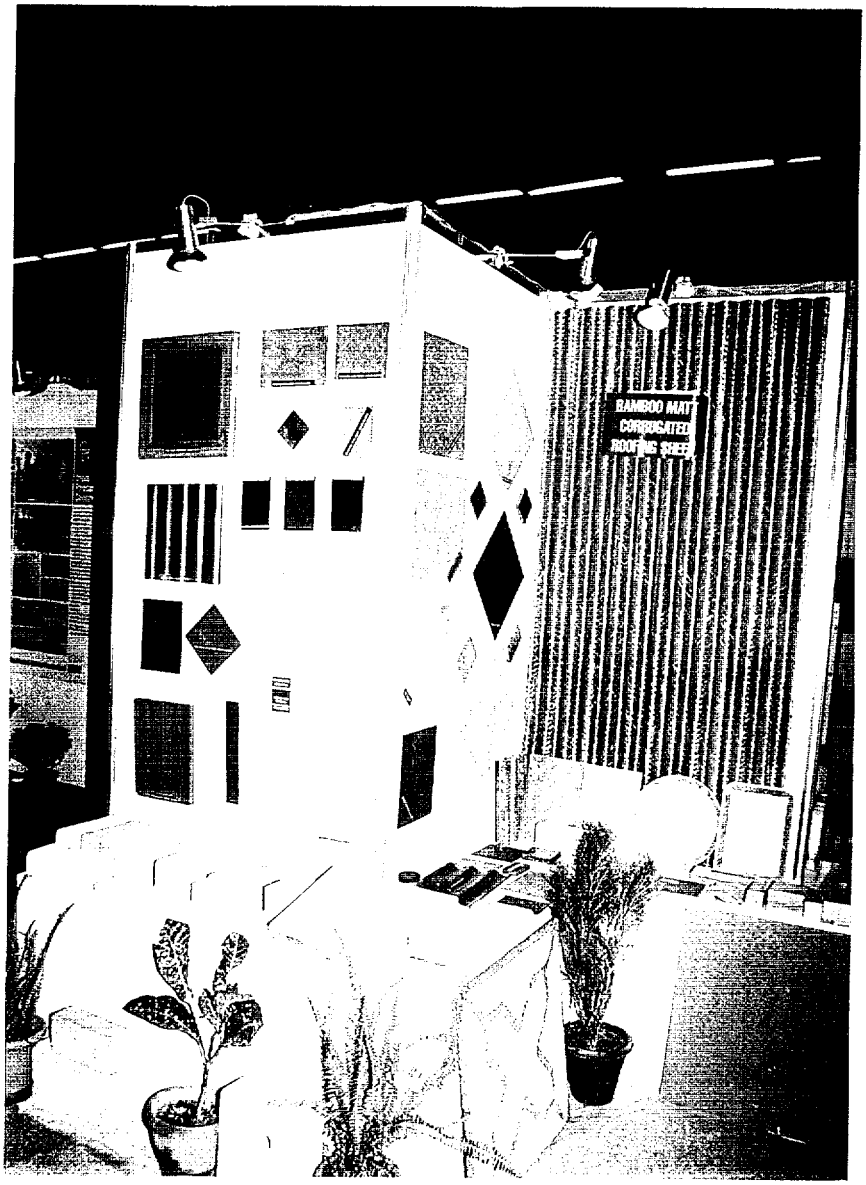
Mr. V. Suresh CMD HUDCO taking around Mr. Suresh Prabhu, Hon. Minister for Environment and Forests and Mr. Bandaru Dattatraya Hon'ble Minster of State for Urban Development, Mr. Micheal Kafabusa Werikhe, Hon'ble Minister of State for Housing & Communications, Government of Uganda, in the HUDCO's stall

Mr. Bandaru Dattatraya Hon'ble Minster of State for Urban Development showing keen interest in the Concrete Block technologies by Bessar in Larsen & Toubro stall.

A view of the BMTPC's stall at the Build India'99



Another view of the BMTPC's stall in Build India'99



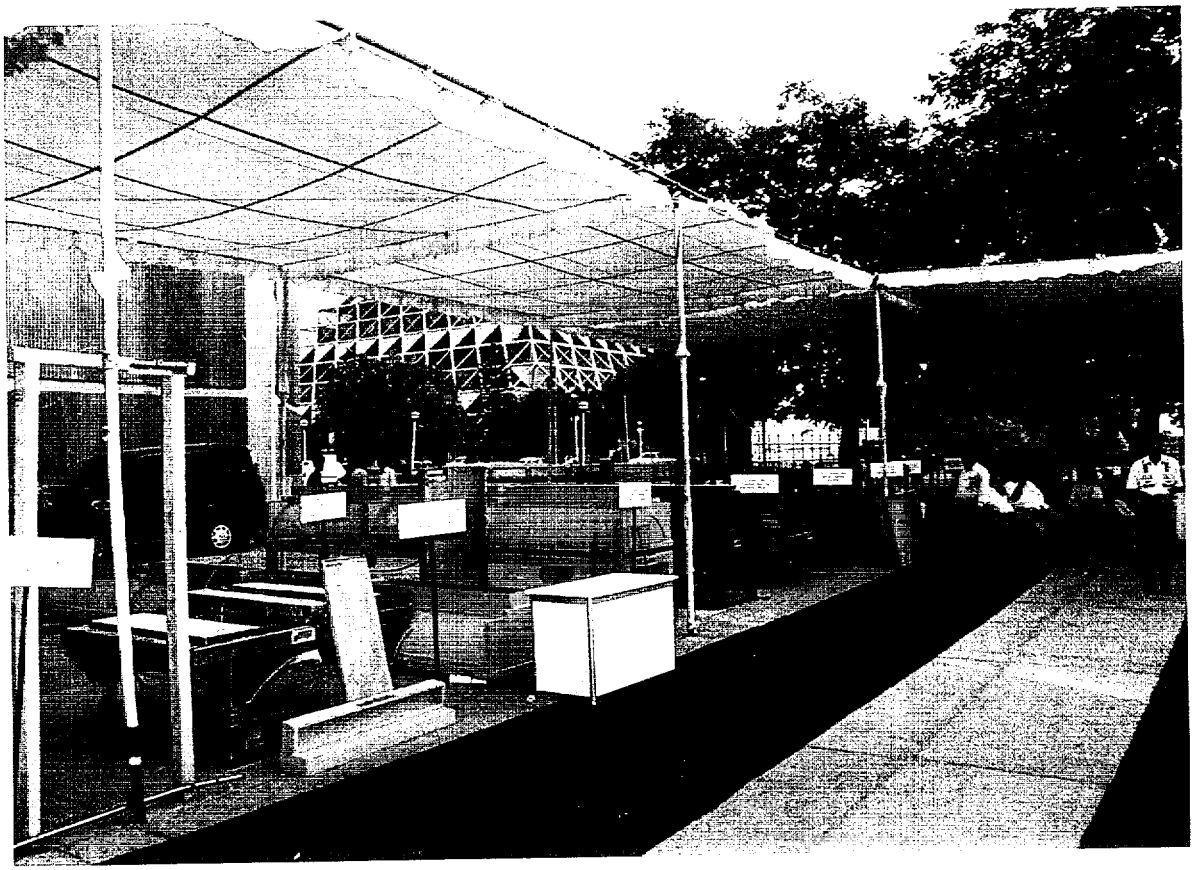
Environment friendly
Innovative
Building Products
on display at the
BMTPC's stall

Panels showing international exhibitions organised by BMTPC in various countries

Visitors flocking for information in the BMTPC stall.

Mr. T.N. Gupta showing some innovative product to Mr. Dalip Biswas Chairman Central Pollution Control Board at the BMTPC stall

LIVE DEMONSTRATION OF MACHINES



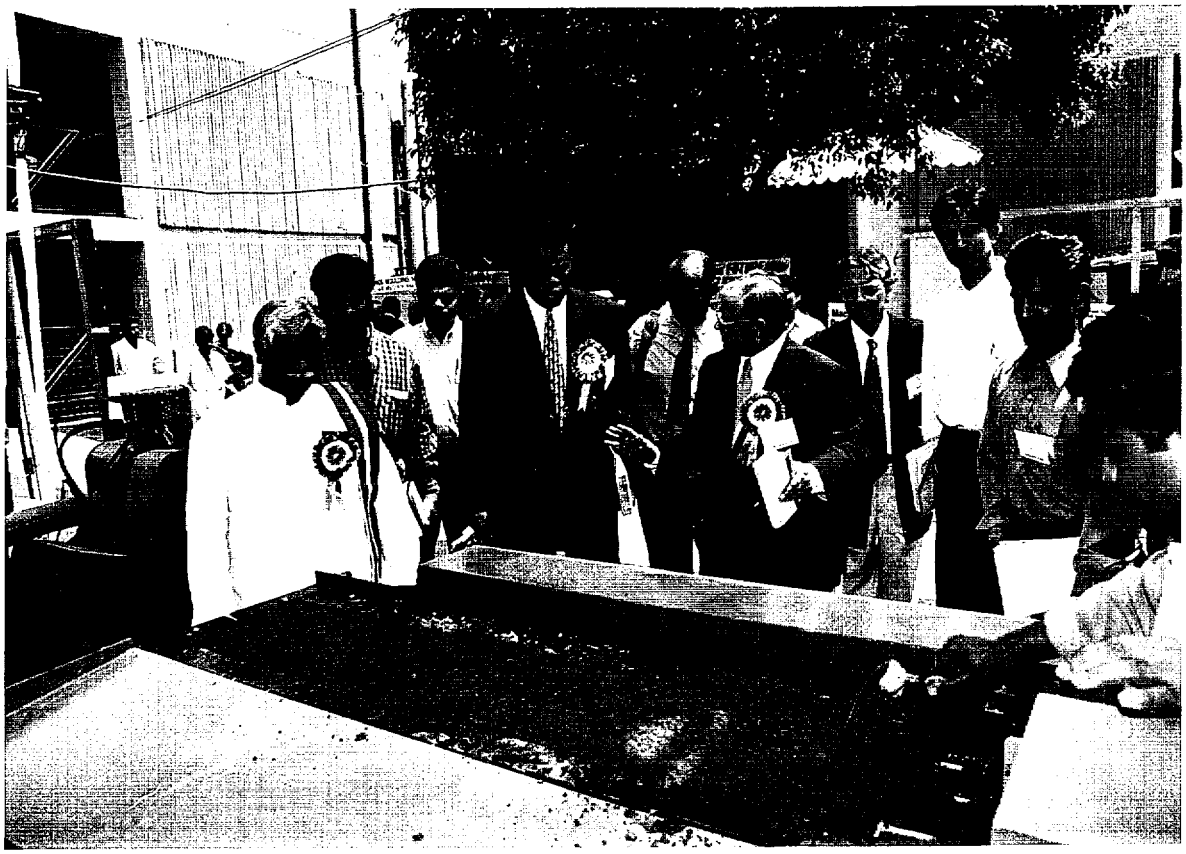
A view of the machines developed by BMTPC on display during the exhibition

Another view of the machines developed by BMTPC on display during the exhibition

Mr. Bandaru Dattatraya Hon'ble Minster of State for Urban Development. Mr. Micheal Kafabusa Werikhe. Hon'ble Minister of State for Housing & Communications. Government of Uganda. taking interest in the demonstration of concrete door and window frame making machine

Mr. Bandaru Dattatraya Hon'ble Minster of State for Urban Development. Mr. Micheal Kafabusa Werikhe. Hon'ble Minister of State for Housing & Communications. Government of Uganda. viewing the flyash bricks promoted by BMTPC.

Mr. Bandaru Dattatraya Hon'ble Minster of State for Urban Development, Mr. Micheal Kafabusa Werikhe. Hon'ble Minister of State for Housing & Communications, Government of Uganda, taking keen interest in flyash bricks



Mr. Bandaru Dattatraya Hon'ble Minster of State for Urban Development, Mr. Micheal Kafabusa Werikhe. Hon'ble Minister of State for Housing & Communications, Government of Uganda taking interest in the machines promoted by BMTPC

Visitors showing interest in the live demonstration of the machines developed by BMTPC

Another view of the machines and products developed by BMTPC. Mr. T.N. Gupta, ED BMTPC is explaining about the machines to Mr. Z. Hasan, Secretary Ministry of Water Resources.

CONFERENCE BANQUET, CULTURAL FUNCTION, & INDUSTRY NITE

The Conference Banquet in the process

Mr. T.N. Gupta ED BMTPC having a chat with Mr. Micheal Kafabusa Werikhe. Hon'ble Minister of State for Housing & Communications, Government of Uganda

Ms. Shagun Bhutani presented an Odissi Dance performance for the delegates.

Another view of the Odissi dance performance

A view of the 'Industry Nite' Celebrations where all the exhibitors and foreign participants participated

LIST OF AUTHORS

LIST OF PAPERS CONTRIBUTED BY INTERNATIONAL DELEGATES

S. No.	Name of the author & address	Title of the paper
1	Mr. Richard Ley, Arif Humayun BIEC International Inc., WA, U.S.A.	Coated Sheet Steel for Construction – Eco-Friendly, Energy Efficient and Cost-Effective
2	Prof. Xu Qiang Shanghai Research Institute of Building Sciences, Shanghai, China	Volume Soundness of High Calcium Fly Ash
3	Ms. Sarah Ibanda Commissioner, Ministry of Works, Housing and Communications, Govt. of Uganda, Kampala, Uganda	Environmental Protection and Energy Saving through Disposal and Recycling of Wastes: Wastes from Industry, Agriculture and Future Possibilities - Uganda Chapter
4	Mr. Carlo Valente Peracino Welco Industriale SpA, Italy	Urban and Industrial Waste Recovery as Raw Material for Ceramic Bodies
5	Mr. Giorgio Bressi Tecnitalia Consultants, Milan, Italy	Recycling of Construction and Demolition Waste: The Italian Technology
6	Mr. Walter Merzagora*, Ariel Paggi** *Ambiente S.p.A., **Trading & Consulting Milan, Italy	Use of Tannery Sludges in a Brick Factory for the manufacture of Bricks and Tiles
7	Prof. Della M. Roy Materials Research Laboratory, The Pennsylvania State University, U.S.A	High Performance Cementitious Materials for the Building Industry Utilising By-product Materials: Potential Advantages
8	Dr. Debes Bhattacharyya, K. Jayaraman, M. Bowis, C. Boyle University of Auckland, Auckland, New Zealand	Waste to Product Manufacturing : A Scenario with Waste Plastic/Natural Fibre Composites
9	Dr. V.T.L. Bogahawatta, N.B.M. Ranatunge National Building Reserach Organisation, Colombo, Sri Lanka	Agricultural and Industrial Wastes as Secondary Resources for Building Materials - Present State and Future Prospects in Sri Lanka

10	Mr. D. Ruys, Alan Crosky, W.J.Evans* University of New South Wales, Sydney, Australia *University of Wales, U.K.	Ecologically Sustainable Composite Materials for Low Energy City Vehicles
11	Mr. Wambuzi Ivan Uganda National Council for Science and Technology, Kampala, Uganda	Institutional Arrangements for Utilisation of Waste-based Building Technologies in Uganda
12	Ms. Maria Joao Nazareth, Fernando Amade Ministry of Planning and Construction, Government of Mozambique	Indicative to Design Building Materials from Recycled and Natural Products of Mozambique
13	Mr. Jonah M. Ichoya Jonah Consult Zambia Ltd., Lusaka, Zambia	Housing Problems in Sub-Saharan Africa : The case for Waste and By-products Resources for Building Materials
14	Dr. E.T.N. Bisanda University of Dar-Es-Salaam, Dar-Es-Salaam, Tanzania	Indigenous Materials from Agricultural Wastes for the Tropical Regions of Africa
15	Mr. Joel K. Kateregga ECO-Shelter & Environmental Consultants, Kampala, Uganda	Promoting Bamboo as a Potential Building Material for Low Income Housing
16	Mr. Albert Butare Kigali Institute of Science, Technology and Management, Kigali, Rwanda	Utilisation of Bio-digested Effluents from Cow Dung as a Raw Material for Rural Housing in Rwanda
17	Mr. Maurice M. Chitondo National Housing Authority, Lusaka, Zambia	Selection Criteria for Waste and By-products as Secondary Resources for Producing Composite Building Materials for Affordable Housing in Developing Countries
18	Mr. W.Balu Tabaaro Department of Geological Survey and Mines, Entebbe, Uganda	Potential Use of Waste and by-Products for the Production of Building Materials for Low Cost Housing in Uganda

LIST OF PAPERS CONTRIBUTED BY INDIAN DELEGATES

S. No.	Author & Address	Title of the Paper
1	Dr. R.N. Iyengar Director Central Building Research Institute, Roorkee	Solid Industrial Wastes as Secondary Resource Material in Building Sector
2	Mr. Vimal Kumar, C.N.Jha, Preeti Sharma FLYASH MISSION (TIFAC), Department of Science & Technology, New Delhi, India	Fly Ash - A Fortune for the Construction Industry
3	Mr. Shyamal Roy Coal Ash Institute of India, Calcutta, India	Coal Ash- The Ingredient to Build Infrastructure
4	Mr. V. Sriraman, Arun Kumar Development Alternative, New Delhi, India	Waste based Building Materials
5	Mr. G.B. Singh System Building Technologists, New Delhi, India	Normally Cured, Site Produced, Flyash based "Cellular Light weight Concrete"
6	Mr. Ved Prakash Sand Plast (India) Ltd., New Delhi, India	Fly Ash Products as Resource for Alternate Building Material
7	Dr. Mohan Rai Former Scientist, CBRI, Roorkee	Potentials of Utilisation of Metal Ore-Dressing Tailings in Building Materials
8	Mr. J. Sengupta, Mr. T.N.Gupta Building Materials & Technology Promotion Council, New Delhi	Some Issues Related to Commercial Exploitation of Agricultural residues for manufacture of Building Materials and Components
9	Ms. Sangeeta Tiwari, Dr. Mohini Saxena Regional Research Laboratory, Bhopal	Formulation of Paints for Building Applications using Indigenous Materials
10	Mr. A. Anjaiah Dual Fabs (I) Ltd., Chennai, India	Flyash in the Production of Building Materials - A Case Study of Pioneering Initiative

11	Mr. R.Krishnamurthy, A.K.Mathur National Thermal Power Corporation Ltd., Noida, India	Ash Utilisation in NTPC
12	Dr. G.Balasubramanian, M.T.Nimje, R.S.Mishra, Prof.T.R. Ramachandran Jawaharlal Nehru Aluminium Research Development and Design Centre, Nagpur	Utilisation of Metallurgical Wastes in the Building Material Industry
13	Dr. C.B. Raju, B.Chakradhar, J.Prabhakar, Prabha Padmakaran, R.S.Ahirwal, Dr. M. Saxena, Amit Rai* Regional Research Laboratory, Bhopal *Building Materials & Technology Promotion Council, New Delhi	Study on Some Special Features of Slags from Ferroy-Alloy Industry for Exploring New Construction Materials
14	Dr. N. Bhanumathidas, Dr. N.Kalidas Institute for Solid Waste Research & Ecological Balance, Vishakhapatnam	The Rationale for Portland Pozzolana Cement Composition
15	Mr. S. Renganathan Vijay Constro Chemicals Pvt Ltd., Rajapalayam	Concrete Corrosion Control by Rust Converter Coating System
16	Mr. Deepak Narayan, Jose Kurian Central Public Works Deptt., New Delhi	Use of Blended Cement in Concrete Construction in India
17	Mr. P.G. Lele, V.K.Gore, S.A.Khadilkar, R.M. Cursetji The Associated Cement Companies Ltd, Mumbai	Valorization of Industrial Wastes through use in Cement Manufacture- Illustrative Case Studies
18	Prof. P.C.Borthakur, D.Bordoloi, A.C.Baruah, P.Barkakati Regional Research Laboratory, Jorhat Assam	Promotion of Small Scale Cement Manufacturing Based on Agro-Industrial Waste
19	Dr. K. Ramamurthy, K.S.Gumaste Indian Institute of Technology, Chennai	Behaviour of Masonry Prisms with Recycled Aggregate Concrete

20	Dr. K. Ramamurthy, Dr. N.Narayanan Indian Institute of Technology, Chennai	Influence of Flyash on the Properties of Aerated Concrete
21	Dr. S.Gopalakrishnan Structural Engineering Research Centre, Chennai	Durable Concretes using Mineral Waste Materials - An Overview of SERC's Experience
22	Prof. P.Sengupta, N.J.Saikia, D.K.Dutta, P.C.Saikia, P.C.Borthakur Regional Research Laboratory, Jorhat	Oil Field Sludge in Building Brick Production
23	Prof.K.G. Satyanarayana, K.G.K.Warrier, C.Pavithran Regional Research Laboratory, Thiruvanathapuram	Development of Building Materials based on Agro and Industrial Wastes and Innovative Processes
24	Mr. O.P. Ratra Reliance Industries Ltd., New Delhi	Plastics Waste: Environmentally Potential Source for Composite Materials and Energy Recovery
25	Mr. Arun K. Bansal, Mr. S.S. Zoolagud Indian Plywood Industries Research and Training Institute, Bangalore	Plantation Wood, Bamboo and Lignocellulosics - As Future Source for Building Materials
26	Ms. V.Sorna Gowri, Dr. (Ms) Mohini Saxena Regional Research Laboratory, Bhopa	Studies on Bamboo Polymer Composites with Polyester Amide Polyols as Interfacial Agent
27	Dr. Mohini Saxena, V.Sorna Gowri Regional Research Laboratory, Bhopal	Potentials of Utilisation of Industrial Wastes for Developing Wood Substitute
28	Dr. B. Chakradhar, R.K. Rawlley, I.B. Singh, C.B. Raju, Prabha Padmakaran Regional Research Laboratory, Bhopal	Characterisation and Development of Treatment Technology for Stabilisation of Hazardous Waste for Usable Building Materials

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NEWSPAPER CLIPPINGS

EXPRESS NEWSLINE

15 APRIL 1999

Mobile water lab is a crowd-puller

EXPRESS NEWS SERVICE
NEW DELHI, APRIL 14

INDIA'S first multisectoral environment exhibition, conference and film festival continued to attract visitors for the second day. The exhibition is on till the 16th of this month. One of the biggest crowd pullers was the Central Ground Water Board stall which had a mobile water testing lab. People were seen bringing water samples from their homes and offices to test it for pollutants.

The Building Materials and Technology Promotion Council (BMTPC) had on display machines and technology which could produce cost-effective and eco-friendly building products. For example, on display is a set-up for precasting concrete window and door frames and furniture resembling that made of wood closely, which could help reduce the demand for timber.

Also on display were eco-friendly and cheap building and roofing alterantives.

Among the other exhibitors are the Central Pollution Control Board, Ministry of Environment, the Sardar Sarovar project and Shriram Environment and Allied Services, which displayed water treatment technologies.

The stall belonging to the Housing and Urban Developement Corporation (HUDCO) has information on programmes and initiatives to reduce costs and increasing the supply of materials required for housing and building construction by promoting local available resources with little appropriate technology upgradation.

The Coir Board has a stall which displays the benefits of coir in various forms. Sulabh International displays an interesting model of Bio-energy and bio-fertiliser which successfully converts human waste from a toilet complex into usable energy.

For technical experts, there are stalls catering to their needs exclusively. Fischer, Schlumberger Industries, Besser are some of the companies which are exibiting the latest technologies in their respective engineering fields.

In the conference section, today's focus was on recycling of wastes, the national status on R&D, standardisation, commercialisation of waste management and utilisation.

The second session dealt with the use of wastes as important secondary resources for cement, concrete walling and roofing building components.

Among the international films to be screened on environment there were the Canadian film *Fisheries beyond the Crisis*, which focused on two case studies, one from Canada and one from India. *The Coast, Naturally*, from the Netherlands was about protecting precious coasts from soil erosion.

Among the Indian films were *Gokak Goes Green*, a corporate company's effort to support to the environmnet. *Brick by Brick to Sustainable Developement* was by BMTPC. Tomorrow the exibition will have sessions on emerging technology for building materials and waste management with specialists from all over the world.

Financial Express
15 April 1999

Thermax to set up desalination plant for Nirma Bhavnagar soda-ash unit

Geeta Nair
Pune, April 14

THERMAX'S water treatment division is putting up the country's largest membrane-based desalination plant at Nirma's soda ash plant coming up at Bhavnagar in Gujarat.

The Rs 16-crore project is expected to be commissioned in July 1999 and will be among the few companies recycling seawater to meet its water requirements.

Using seawater has not been popular due to the high capital requirements.

The membranes are expensive and have to be imported and is not made in India and all this leads to high cost of water per unit.

But with traditional sources of fresh water and ground water beginning to dry up and water rates going up alternate sources ranging from sewage water to seawater are being tapped.

A number of plants on the coastal line have already switched to sea water for their cooling plants.

These plants generally use thermal desalination which requires steam. Thermax is using reverse osmosis (RO) as it is cheaper than Thermal desalination.

Thermax, water treatment division, general manager, L Venkateswaran, said, "The membrane technology has been developing at a rapid pace and the pressure required for the membranes to function is also coming down thereby reducing overall costs by 45 to 50 per cent.

He pegged the growth in this segment at around Rs 150 to Rs 200 crore in three years time.

At the Nirma's soda ash plant, Thermax system will incorporate tube settlers and filtration equipment for pretreatment of sea water and reverse osmosis with energy recovery system with a total permeate capacity of 450 cubic metres an hour.

The desalination plant will provide continuous water supply to Nirma's soda ash plant for boiler feed, process and drinking water use.

The plant will supply 2.5 million gallons of fresh water per day.

Part of the water will be used for drinking and service applications while the balance will be passed through mixed bed polishers to get boiler quality water.

The sea water will be treated to attain a level of conductivity and silica content suitable for power plant boiler applications.

In the process Nirma will also be getting a useful by-product.

The highly saline reject will be led to a salt pond for recovery of salt, which will be used for manufacturing soda ash.

Around 100 tonnes of salt will be consumed inhouse and will not be meeting all the requirements of the plant.

Due to this useful by-product the cost of water is likely to come down marginally for Nirma and also provide steady supply of water, which is a scarce resource in the area. ◆

The Hindu
14th April 1999

The Union Minister for Environment and Forests, Mr. Suresh Prabhu, inaugurating the "Build India '99 Environment India '99 Water India'99" exhibition and conference in New Delhi on Tuesday.

People's role in eco-protection

By Our Staff Reporter

NEW DELHI, April 13.

Without abdicating the Government's role in protecting the environment, the Union Minister of Environment and Forests, Mr. Suresh Prabhu, today called for people's participation in the endeavour.

Revealing the Government's plans to launch a five- point programme for a clean environment while inaugurating the Build India '99 Environment India '99 Water India '99 exhibition, conference and film festival here today, the Minister said there was a need to change the mindset of the people.

The five points of action of the programme will be clean water, clean air, clean sound, better sanitation and plantation of trees.

lation on Municipal Solid Waste. The urbanisation of India, he said, had created the need for such legislation that would address the collection, segregation, recycling and disposal of solid waste.

Another legislation that will be in place soon is one pertaining to polythene bags. The Ministry, Mr. Prabhu said, had issued a Draft Notification and would soon be coming out with a final Notification that would provide guidelines on the thickness of plastic bags and the purposes for which they could be used.

Given the fact that rapid industrialisation has become a necessary evil — creating as it does employment and wealth — Mr. Prabhu stressed that scientists and technologists need to find a way by which the environment can be spared the harmful effects of industrialisation.

said. Environment Audit would soon become compulsory for all companies who pollute.

Companies will have to conform to ISO 14000 ratings. In a bid to force environment consciousness on the corporate sector, a practice of 'Green Ratings' will also be introduced.

The Central Pollution Control Board, the Minister informed, was in the process of bringing out emission norms for each section of industry.

The four-day event will showcase expertise and technical know-how in the development and application of eco- friendly building materials, environment-friendly technologies, and water-management processes in the Indian industry.

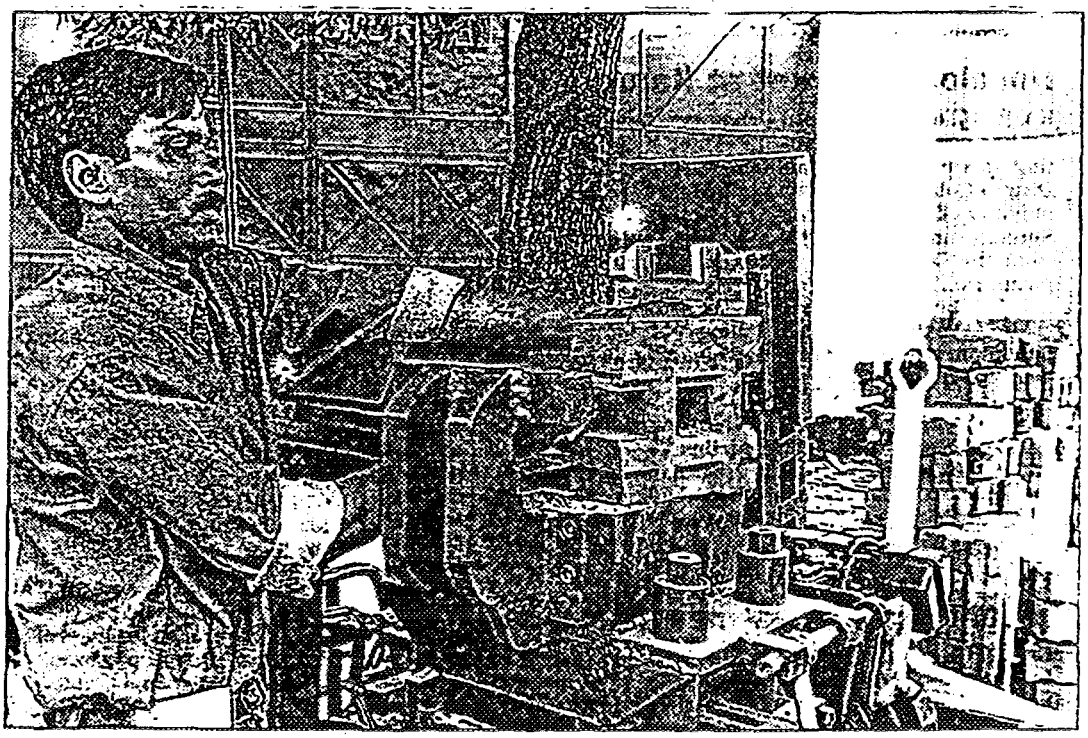
Besides bringing together diverse but congruent ideas — the multi- faceted exhibition is

Hindu Business Line
14th April 1999

Environment audit to be made mandatory

Our Bureau
NEW DELHI, April 13

Ramesh Sharma



Hi-tech bricks being prepared during the Build India '99 exhibition in New Delhi on Tuesday.

THE Centre has decided to make it mandatory for all polluting companies to conform to ISO 14000 standards. This was stated by the Union Minister for Environment & Forests, Mr. Suresh Prabhu, at the inauguration of a four-day joint exhibition - Build India'99, Environment India'99 and Water India'99, organised by the Building Materials & Technology Promotion Council here.

Mr. Prabhu said an environment audit would soon be made compulsory, followed by the introduction of 'green ratings' for all these companies. In this context, he said the Central Pollution Control Board was in the process of bringing out emission norms for each section of the industry.

He also noted that the Ministry was framing a comprehensive legislation on the disposal of municipal solid waste. "This will be a major step because the bulk of the country's population will soon live in urbanised areas. The legislation will address the segregation, recycling and disposal of this waste. Fiscal incentives as well as other benefits will be given to make it attractive for private sector participation in this area," he said.

On polythene bags, the Minister said his Ministry has already prepared a draft notification aimed at regulating their usage. It will soon be finalising the notification which will address the question of thickness and for what purposes the bags can be used.

He said his Ministry was to launch a five-point programme for a clean environment. The Minister also added that to improve the environment in the country, a change should be wrought in the mindset of the people.

Rapid industrialisation has brought in its wake problems and difficulties, Mr. Prabhu said. "At the same time, industrialisation is a necessary evil as it creates massive levels of employment, wealth and adds to the gross domestic product. In recent years environmental concerns have developed as it has become evident that industrialisation destroys natural resources. The challenge for technologists and scientists is to find out a way where both can exist side by side," he said.

Illustrating these concerns, the Minister gave the example of flyash from power plants. He said that every year 60 million tonnes of flyash is created and that by the end of the year 2000, this figure is expected to go up to 100 million tonnes. Huge landfills will have to be created to dispose this flyash. However there are many ways in which this by-product can be used in an environment-friendly way.

He said that his Ministry had recently taken the initiative to work out ways in which flyash could be put to better use. It had brought the Ministry of Power and the Ministry of Urban Affairs & Employment to agree that all power plants would use flyash in the shortest possible time for alternate purposes.

The Urban Ministry has also agreed to use construction material made from flyash wherever possible.

Business Standard
14th April 1999

5-yr tax holiday planned for waste handling units

Our Environment Editor
NEW DELHI

Several fiscal incentives, including a five-year tax holiday, are proposed to be offered to the private sector for taking up projects on biodegradable waste management

Inaugurating a combined international meet — 'Build India '99, Environment India '99 and Water India '99, environment and forests minister Suresh Prabhu said a comprehensive legislation on how to regulate the business of solid waste management was on the anvil. The concerned notification would be issued shortly.

The notification will lay down norms and procedure on waste collection, segregation, processing and disposal in a manner that does not pose a threat to environment and human health. Beside, it will offer a package of fiscal incentives so that the private sector is encouraged to take up waste management activities.

The minister outlined the initiatives the government had taken in checking pollution in the different sectors and made it clear that while the government would like that the prescribed norms and standards were complied with voluntarily, stringent punishment would be meted out to those who violate them.

Prabhu informed that the Central Pollution Control Board was already engaged in setting standards so that no segment of environment was left out.

He disclosed that the environment ministry was all set to launch a five-point action plan on environment. The thrust would be on clean water, clean air, controlled noise level, better sanitation and tree plantations.

The four-day event organised jointly by the Building Materials and Technology Promotion Council, ministry of urban affairs and Employment and Exhibition India Pvt Ltd, showcases eco-friendly technological advancements in fields like building materials and water management. An international film festival on environment has also been organised on the occasion.

The Pioneer
14th April 1999

Prabhu asks industry to be eco-friendly

New Delhi: Minister of Environment and Forests, Suresh Prabhu has called upon the business community to be equal partners in the country's environment protection strategies and encourage the use of eco-friendly technologies.

Speaking atenvironment exhibition conference and film festival, Build India '99/Environment India '99/Water India '99, he said that the government has drawn an environnment protection plan incorporating provisions of maintaining strict environmental discipline through effective regulatory body. *PNS*

The Asian Age
14th April 1999

5-point plan on anvil for clean environment

BY OUR CORRESPONDENT

New Delhi, April 13: The Union ministry of environment and forests will launch a five-point programme for environment conservation. The programme called the "Clean Environment" was announced by minister of environment and forest Suresh Prabhu while inaugurating the Build India 1999, Environment India 1999, Water India 1999 Exhibition, Conference and Film Festival in the city on Tuesday. Mr Prabhu said the five points of action will be clean water, clean air, clean sound, better sanitation and plantation of trees.

The business community must be equal partners in protecting the environment, Mr Prabhu said. He said the government has proposed a five-year tax holiday to private sector companies engaged in the business of bio-degradable waste management. The initiative hopes to encourage private participation in the water management sector to contain health and environmental hazards. Soon, an environment audit will be made

■ Turn to Page 11

Environment plan

■ Continued from Page 9

compulsory for all companies which pollute. These companies will have to conform to ISO 14000 ratings, Mr Prabhu said. The next step would be the introduction of green ratings for companies, he added.

The Centre is also notifying a comprehensive legislation to deal with collection, segregation, processing and disposal of solid wastes. Many fiscal incentives would be incorporated into the legislation which would help the corporate sector to effectively mange waste, Mr Prabhu said. The legislation also envisages massive inflow of foreign direct investment into the sector.

The environment minister also said that the Central Pollution Control Board is in the process of bringing out emission norms for each section of the industry.

Speaking at the inaugural function, minister of state for urban affairs and employment said the government was keen to improve the speed and efficiency in the housing and construction sector for which development of building materials industry is crucial. He emphasised the need of developing eco-friendly alternative materials and technologies for the building materials.

The four-day event will showcase expertise and technical know-how in the development and application of eco-friendly building materials, environment-friendly technologies and water management processes in the Indian industries. According to the organisers, the exhibition is expected to open up joint ventures, R&D programmes, procurement and licensing exercises in technology flows by facilitating transfer of information and technology from service providers and manufacturers from over 73 international and Indian manufacturers.

THE FINANCIAL EXPRESS

4TH APRIL

Event in Delhi to showcase cleaner technologies

by SOUMYA SARKAR

ECO-FRIENDLY and cleaner technologies for a greener millennium will be the focus of India's major environment exhibition, conference and film festival to be held during April 13-16, 1999, at Pragati Maidan, New Delhi. The event will showcase products and technologies providing multi-sectoral linkages in three different three exhibitions: Environment India 99, Build India 99 and Water India 99. It will be the first event of its kind that offers to blend business with viable products and concepts essential for protecting the environment.

Says Prem Bahl, managing director, Exhibitions India Pvt. Ltd, organisers of the event: "This is designed to address the 21st century challenge of meeting human needs with environmentally sustainable technology." According to him, 30 per cent of the companies that exhibited their ware last year are participating this year, too. "The percentage reflects the company policy of several organisations to exhibit only once in two years. Many international companies who participated in Environment India 98 have confirmed their participation next year," Bahl points out.

The Environment India 99 exhibition will focus on technologies and services in areas of environment management, environmental engineering, environmental protection, effluent treatment, pollution control, solid waste management, non-conventional sources of energy, alternate energy sources, land reclamation, noise control, environment impact assessment, environmental audit, etc.

Build India 99 will address issues related to effective utilisation of waste through technology options. Based on the theme 'Waste to Wealth', the exhibition will focus on the commercial viability of waste minimisation through the production of building materials and components, industrial derivatives and composites as substitutes for building applications; combining industrial residues with alternatives for production of construction materials, and innovative materials and construction systems for low-cost housing.

The exhibition will take a comprehensive view of all the aspects related to the sector such as sustainable production of building materials and components based on recycling of wastes; waste valorisation techniques for flyash, etc; production technology for agro waste such as rice husk, jute, bamboo etc; building materials from recycling of wastes; eco-friendly and energy efficient alternatives to traditional building materials; building materials from plantation timbers; wood based products, etc.

Water India 99 will draw attention to the intrinsic need to link the availability of pure water to human growth and development. This exhibition will specially focus on the necessity of appropriate technologies and infrastructure in supply of water. The highlights of 'Water India 99 will be industrial and municipal waste water treatment, conservation, recycling, distribution, sampling, analysis, purification, drinking water, pumps, pipes, valves, filtration equipment, etc.

Leading national and international companies are participating in this four day event. One of the major highlights of the event will be the international conference on cleaner technologies and waste management. Some of the issues to be addressed include:

- Indian environmental scenario, pollution control, and environmental policy and regulation to be coordinated with the ministry of environment and forests
- Waste and its byproducts as secondary resources for building materials to be organised by Building Materials and Technology Promotion Council and International Centre for Science and High Technology, UNIDO Italy.
- Municipal solid waste management to be co-sponsored by RITES.

A special feature of the event will be the international film festival on the theme 'Corporate Environmental Excellence'. The objective of this film festival is to disseminate information and draw the attention of corporates towards the necessity of cleaner technologies in commercial production. The films will feature success stories on various environmental aspects and will provide a window to motivate entrepreneurs towards adopting cleaner technologies and solutions. ◆

THE PIONEER

5TH APRIL

Environment exhibition from April 13

Eco-friendly and cleaner technologies for a greener millennium will be the focus of the environment exhibition, conference and film festival to be held in the Capital from April 13-16 at Pragati Maidan. Environment India, Build India, Water India '99 showcase products and technologies providing multi-sectoral linkages.

HINDUSTAN TIMES

9th April '99

NEW DELHI FRIDAY APRIL 9 1999

Exhibition on eco-friendly technologies for greener future

HT Correspondent
New Delhi, April 8

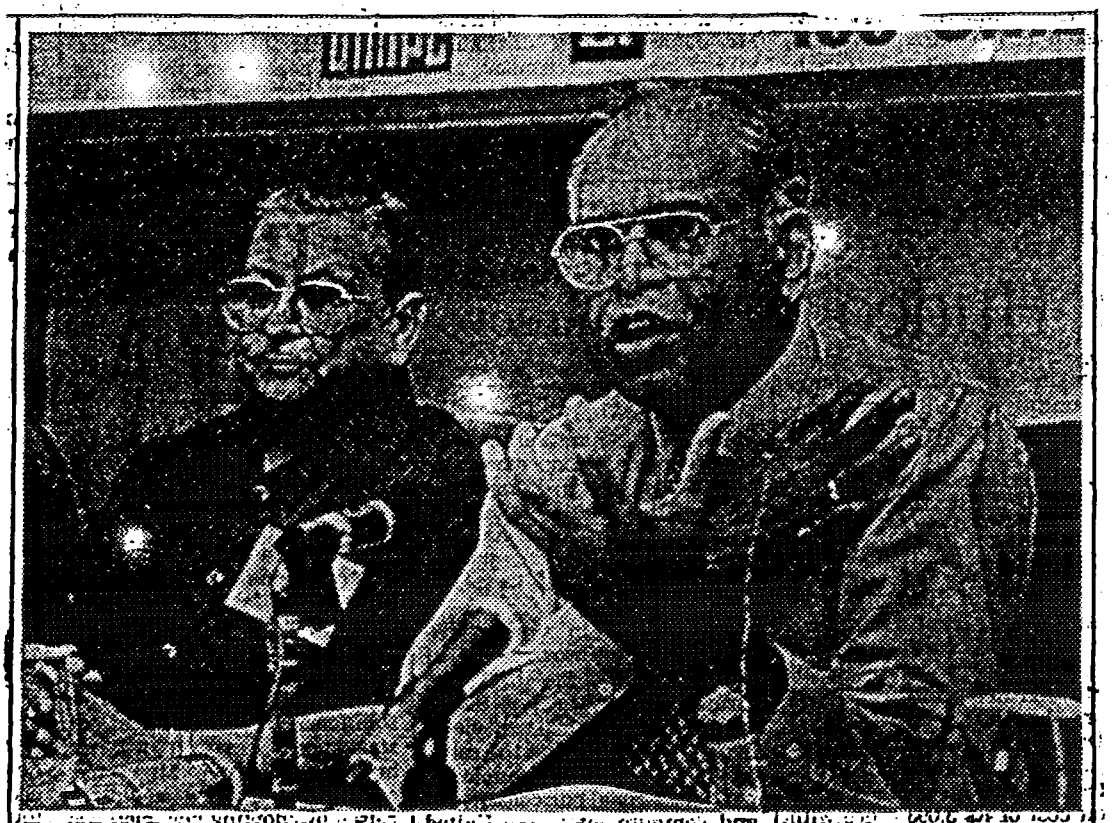
A MAJOR multi sectoral exhibition, conference and film festival with a focus on eco-friendly technologies for greener future "Build India/Environment India/Water India'99 will be held during 13-16 April at Pragati Maidan.

The four-day event will showcase expertise and technical knowhow in the development and application of eco-friendly building materials, environments friendly technologies and water management processess in Indian industry, and bring about better awareness of the immense business and investment opportunities in environment industry. The exhibition will open-up joint venture, R& D programmes, procurement and licensing exercises in technology flows and so on by facilitating transfer of information and technology from service providers and manufactures from over 73 international and Indian exhibitors representing the entire industry.

One of the highlights of the event will be the international conference on waste management Eminent experts, policy makers and academicians will address the conference. The inaugural session will be an introduction to the Indian environmental scenario highlighting regulation and policy for sustainable development, effective control of Industrial and Urban air pollution in Indian industries.

THE OBSERVER OF BUSINESS AND POLITICS

9 APRIL 1999



The HUDCO Chairman, Mr. V Suresh (right), and the BMTPC Executive Director, Mr. T N Gupta, at a press meet on 'Build India '99', in New Delhi on Thursday. ■ L M Joshi

Times of India
9th April 1999

Eco-friendly building material

A four-day international exhibition, conference and film festival on the related issues of ecologically-friendly building materials, environmental technology and water management is being held at Pragati Maidan from Tuesday.

THE HINDUSTAN TIMES

11 APRIL 1999

Build India 1999

BUILD INDIA, Environment India and Water India, a mjor multi-sectoral exhibition, conference and film festival centred around promotion of eco-friendly technologies would be held at Pragati Maidan during April 13-16, 1999. The 4-day extravaganza cum corporate showcasing of technologies is being promoted by Building Materials & Technology Promotion Council and Exhibitions India Ltd.

HTC, New Delhi

OUTLOOK

12 APRIL 1999

RECOMMENDATIONS

EXHIBITION

Build India '99

■ International Exhibition, Conference & Film Festival
Pragati Maidan, New Delhi April 13-16

AN opportunity to attend India's leading international exhibition, conference and film festival on eco-friendly building materials, environmental technologies and water management. The four-day event will cover all aspects

of modern environmental management and solutions including air pollution control technology, environmental engineering, eco-friendly products/technology, waste management and recycling, sustainable and agro-based building materials, etc. A film festival will screen case studies of technologies adopted by corporates, associations and individuals the world over to contain pollution. To register contact Sowmya Sriram, C-390, Defence Colony, New Delhi. You could also call (011)4633506 or e-mail exhibitionsindia@vsnl.com.

OBSERVER
27TH MARCH 1999

Eco-friendly technology show opens on April 13

Observer Economic Bureau

NEW DELHI

THE Ministry of Urban Affairs and Employment and the Ministry of Water Resources are jointly hosting an exhibition, the focus of which will be "Eco-friendly and Cleaner Technologies for a Greener Millennium".

The exhibition, which also includes a film festival on the same subject, is to be held at Pragati Maidan from April 13 to April 16, 1999. The event will show-case products and technologies, providing multi-sectoral linkages. The themes will be Environment India '99, Build India '99 and Water India '99. This will be the first event of its kind, to blend business interests with viable products and concepts essential for protecting the environment.

Highlighting innovative technologies, alternative options and cost effective mechanisms to safeguard the environment, the event will provide an ideal platform to link policy options with the new generation environment friendly technologies, in order to combat environmental problems in developing countries.

Environment India '99 will focus on technologies and services in areas of environmental management, environmental engineering, environmental protection, effluent treatment, pollution control, solid waste management, non-conventional sources of energy, alternate energy sources, land reclamation, noise control, environment impact assessment and environmental audit, among others.

Build India '99 will address issues related to effective utilisation of waste through technology options. The event will focus on combining industrial residues with alternatives, for producing construction materials and low cost housing.

Water India '99 will draw attention to the intrinsic need to link the availability of pure water to human growth and development and will focus on the necessity of an appropriate technology and infrastructure in the supply of water. The highlights of the event will be industrial and municipal waste treatment. ❑

The Hindu
26 March 1999

Focus on eco-friendly technology

By Our Staff Reporter

NEW DELHI, March 25.

"Eco-Friendly and Cleaner Technologies for a Greener Millennium" will be the focus of India's major environment exhibition, conference and film festival to be held from April 13 to 16 at Pragati Maidan in the Capital.

Showcasing products and technologies providing multi- sectoral linkages, Environment India '99 will be the first event of its kind offering to blend business interests with viable products and concepts essential for protecting the environment, according to an event management company release.

Highlighting innovative technologies, options and cost-effective mechanisms to safeguard the environment, the event will provide an ideal platform to link policy options with the new generation environment technologies to combat environmental problems in developing countries.

Environment India '99 exhibition will focus on technologies and services in areas of environmental management, environmental engineering, environmental protection, effluent treatment, pollution control, solid waste management, non- conventional sources of energy, alternate energy sources, land reclamation, noise control, environment impact assessment, environmental audit, etc.

Concurrent with Environment India '99 will be another exhibition showcasing effective utilisation of waste through technology options. Known as "Build India '99," it will be based on the theme "Waste to Wealth" and will focus on commercial viability of waste minimisation through production of building materials and components, industrial derivatives and composites as substitutes for building applications, combining industrial residues with alternatives for production of construction materials, innovative materials and construction systems for low-cost housing.

The exhibition will take a comprehensive view of all aspects to the sector such as sustainable production of building materials and components based on recycling of wastes; waste valorisation techniques for flyash, production technology for agro-wastes such as rice-husk, jute, bamboo, building materials from recycling of wastes, eco-friendly and energy efficient alternatives to traditional building materials and building materials from plantation timbers, wood-based products, etc.

Water India '99 will draw attention to the intrinsic need to link the availability of pure water to human growth and development and will specially focus on the necessity of appropriate technology and infrastructure in the supply of water. The highlights of Water India '99 will be industrial/municipal waste water treatment, conservation, recycling, distribution, sampling, analysis, purification, drinking water, pump, pipes, valves, filtration equipment, etc.

Leading national and international companies will be participating in this four-day event. The participants are Advisory Society on Steel Usage — (USA), Asea Brown Boveri Limited, Central Water Commission, Clear Solution (USA), Schlumberger Industries India Limited, Thermax Limited, Titanor Components Limited, WAPCOS, Anand Water Meters, Anand Zenith Private Limited, Ballarpur Industries Limited and many other companies.

One of the major highlights of the event will be the international conference on cleaner technologies and waste management to be addressed by the experts, policy-makers and academics. A special feature of the event will be the International Film Festival on the theme "Corporate Environment Excellence."

Some of the films to be screened during the festival are Green Zone directed by Mr. Rau Burley of Canada, The Green Dream directed by Mr. Harvey Cashore also of Canada, the 3 Ps by the Delhi State Industrial Development Corporation (DSIDC), Hands of Special: Who has got the Power — A film on energy management directed by Janet Boston of the United Kingdom, Jalakhyan, a film on water management by the Centre for Environment Education and Brick by Brick to Sustainable Development by the Tata Energy Research Institute (TERI).

Business Standard
23 March 1999

Green technology exhibition

Our Environment Editor
NEW DELHI

THE EXHIBITION India Pvt Ltd has planned a four day event in Delhi from April 13 on technological options for the new millennium that can improve production efficiency and be environment-friendly.

The exhibition-cum-film screening event will focus on eco-friendly technologies in the fields of waste minimisation, non-conventional energy sources, noise control, environment impact assessment, clean water supply besides environment engineering and environment management.

The Hindu
23 March 1999

Focus on eco-friendly, cleaner technologies

By Our Staff Reporter

NEW DELHI, March 23.

"Eco-friendly and cleaner technologies for a Greener Millennium" will be the focus of Environment India '99 exhibition scheduled to be at Pragati Maidan here from April 13 to 16.

Two other exhibitions — Build India '99 and Water India '99 — will also be organised along with Environment India '99. Several leading national and international companies are likely to take part in the three exhibitions.

The event has been designed to address the 21st Century challenge of meeting human needs with environmentally sustainable technology, according to a press release today.

One of the major highlights of the event will be an international conference on cleaner technologies and waste management, to be addressed by experts, policy makers and academics.

DELHI TIMES

22nd March.

Pollution: Delhi Govt to bare it all, dare it all

Pratyush Kanth

If anyone in your family has gastroenteritis, fluorosis, skin diseases or respiratory problems, don't be surprised. Blame it on "environmental degradation" and "rising pollution" in the national Capital. The Sheila Dikshit government has decided to bring out in the open next month "alarming facts" about these problems and the "measures" it is going to adopt to counter them.

After studying the environment problems in the city, the government has found that more than a third of Delhi's ground water supply is contaminated by fluorides and nitrates which can cause gastroenteritis, fluorosis, and skin diseases. Contamination has occurred due to seepage of untreated industrial effluents in ground water resources and through open unlined drains. Respiratory problems increase during winter because of the high pollution content in the air.

According to a WHO study, Delhi ranks as the seventh most-polluted city in the world. Infants and children in Delhi are exposed to air-pollution levels equivalent to smoking four packs of cigarettes daily. Historic structures like Humayun's Tomb and the Qutab Minar have deteriorated more during the past 20 years than in the 2,000 years that preceded it.

The study further states that continuous discharge of effluents into the Yamuna has rendered it lifeless. Population pressure and rapid-fire introduction of industries and housing complexes around Delhi are playing havoc with the waters of the Yamuna. Delhi's only green lung, 'The Ridge', has been shrinking in size over the years due to encroachments and illegal felling of trees and this has seriously affected the ecological balance of the city. The study also says that the amount of garbage in the city is posing a serious threat to the health of citizens. Plastic bags and other non-biodegradable articles are adding to the problems of effective waste disposal and recycling.

Delhi chief minister Sheila Dikshit says, "This is the outcome of a constantly exploding population, which is stretching Delhi's resources and infrastructure beyond its limits. Unless the people of this city and the government join hands it won't be possible to make Delhi environment-friendly. This problem is multi-dimensional and highly complex with many issues involved." She says, "We have to involve people and give them monitoring power to improve the green areas in their localities — where to plant trees and what kind of trees, for instance. We are going to involve non-governmental organisations working in these areas, as well as residents' welfare associations in this work."

Outlining the proposed solutions, a Delhi government official says, "We plan to ban 15-year-old passenger vehicles, encourage use of car pools and chartered buses, create no-traffic zones and undertake pedestrianisation of shopping areas, stagger working hours/holidays, augment the public transport system to reduce the number of private vehicles in the city, ban burning of biomass, and take up traffic management on a war footing." He adds, "We will introduce battery-operated buses, improve the quality of the fuel supplied and increase the number of CNG outlets, implement measures for scientific handling of disposal of solid wastes and garbage, encourage use of eco-friendly alternative housing materials, involve members of group housing societies, segregate and dispose of household garbage, and ban the production of articles made of virgin plastic meant for carrying edible items."

The government plans to distribute pamphlets on environmental problems and also display posters at all government offices, educational institutions and hospitals. It plans to distribute saplings and meet school principals to highlight the importance of spreading environmental awareness among students. The government will also be calling a meeting with HUDCO, DDA and various associations of architects and will be asking them to spread awareness about environment products and technologies for construction.

The Asian Age
20 March 1999

Greener options for the millennium

BY OUR CORRESPONDENT

New Delhi, March 19: Eco-friendly and cleaner technologies for a greener millennium will be the focus of one of India's major environment exhibitions, conference and film festival to be held during April 13-16 at Pragati Maidan.

"Environment India '99, Build India '99, Water India '99 will be the first event of its kind offering to blend business interests with viable products and concepts essential for protecting the environment," said the managing director of Exhibition India Pvt Limited, Mr Prem Behl.

"Highlighting innovative technologies, alternative options and cost effective mechanisms to safeguard the environment, the event will also provide a platform to link policy options with the new generation environment friendly technologies," he added.

The exhibition will also stress on technologies and services in areas of environmental management, environmental engineering, environmental protection, effluent treatment, pollution control, solid waste management, non-conventional source of energy, land reclamation, noise control etc. Mr Behl said Build India '99, based on the theme, "Waste to Wealth," will focus on commercial viability of waste minimisation through production of building materials and components, industrial derivatives and composites as substitutes for building applications. Water India '99 will draw attention to the intrinsic need to link the availability of pure water to human growth and development. "The highlights will be industrial, municipal waste water treatment, conservation, recycling, distribution, purification etc," Mr Behl said.

One of the major highlights of the event will be the international conference on cleaner technologies and waste management to be addressed by experts, policy makers and academicians. The exhibition is being organised by the ministry of environment and forests, the building material and technological promotion council and the ministry of water resources.

Environment India '99

Focussing on the fact that technology can provide solutions for environment issues. Environment India '99/Build India '99 will create a forum by bringing together global expertise for latest technologies, and help set up joint ventures for their implimentation. Avenues will be created for joint R & D programmes, technology transactions and industrial partnerships. The focus areas will be Air Pollution Control, Environmental Engineering & Protection, Non Conventional and Alternate Engery Sources, Waste Management & Utilization, Water Management & Treatment, Alternate Eco-friendly Building Material & Technology, etc. A high profile conference will be held concurrent to the exhibition, covering all vital aspects of the environment. An international competitive film festival focussed and dedicated to the corporate environment will also be a part of the event.

For more information circle No. 242