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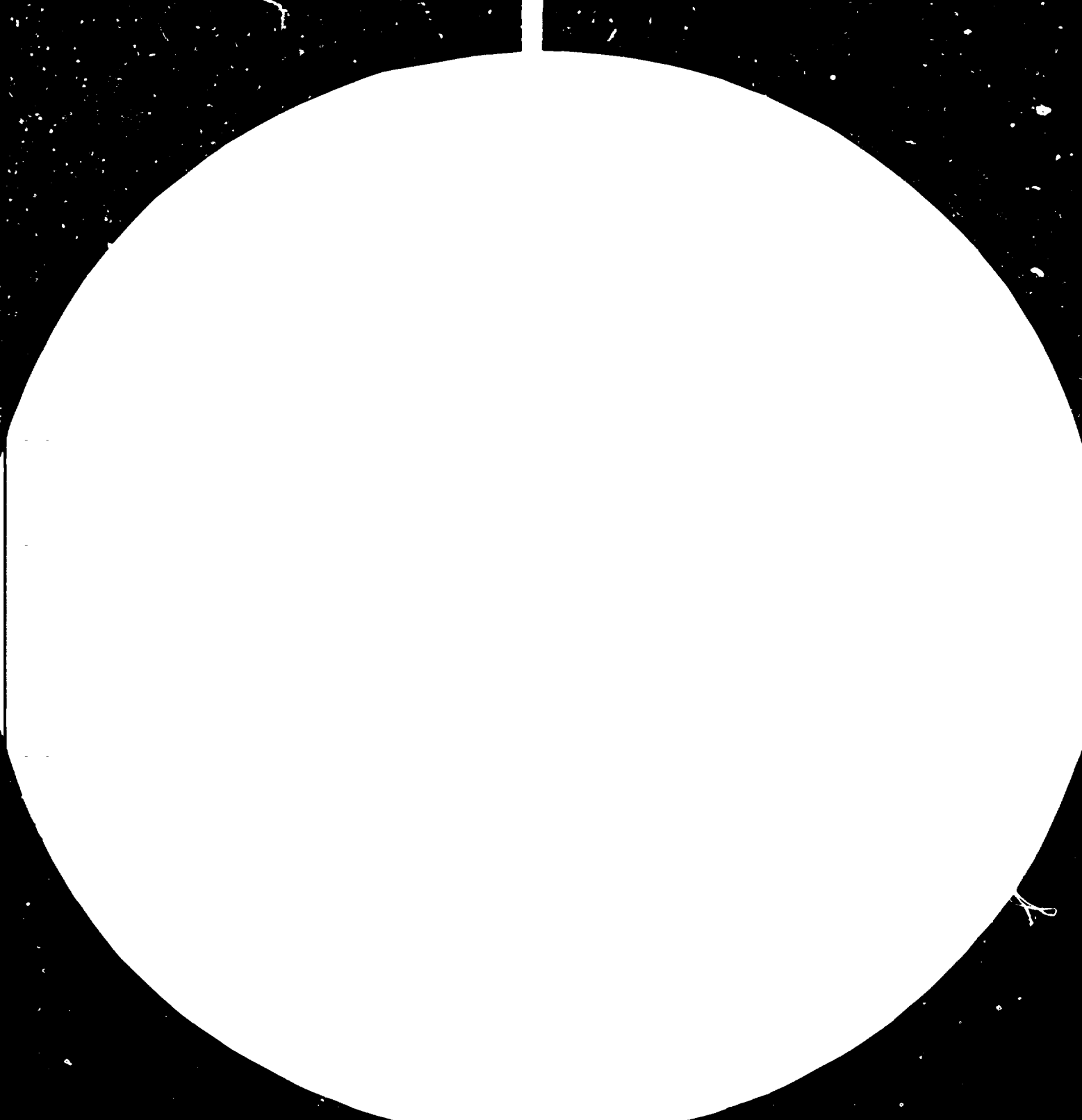
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Ad-hoc Expert Group Meeting in Plastics Technology

27-31 August 1979

Mexico City

PROBLEMS AND PROSPECTS OF INCREASING UTILISATION OF PLASTICS
FOR THE PROVISION AND UPGRADATION OF HUMAN SETTLEMENTS

by O P RATRA
UNIDO Consultant

Ad-hoc Expert Group Meeting in Plastics Technology (Plastics Week)
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PROBLEMS & PROSPECTS OF INCREASING UTILISATION OF PLASTICS FOR
THE PROVISION AND UPGRADATION OF HUMAN SETTLEMENTS

by O.P.RATRA^x UNIDO Consultant

Introduction:

The subject of human settlement, concerns the entire world and more so the developing countries with growing population. According to World Bank Report for 1979, by the end of the century, about one billion more people will live in the cities, and towns of developing world, while the labour force in these countries will have increased by some 550 million—more than twice the increase of the previous quarter century 1950-75. The Report further estimates that by the year 2000, some 40 cities in the developing countries will have more than five million inhabitants, compared with 12 such cities in the industrial ~~world~~ countries. About 18 of these cities are expected to have more than 10 million inhabitants each, while Mexico City may reach a population of 30 million. The task of provision and upgradation of human settlements would thus be enormous and gigantic.

2. While ~~the~~ at administrative and planning levels, a lot has been contemplated in various countries, the commitments of the manufacturing industries including that of plastics, offer rewarding opportunities for the development and promotion of new and improved materials, designs and techniques. In other words, the materials of construction have ~~xxx~~ a major role in promoting the provision of human settlements at various levels.

Priority for Petrochemicals:

3. According to worldwide study carried out by UNIDO, the Latin American ~~x~~ capacity for basic petrochemicals is expected to leap from 2,866,000 metric tons/year in 1977 to 9,550,000 metric tons/year by 1985. Petrochemicals offer good opportunities for industrialisation in the Third world because ~~of~~ those countries have most of the world's hydrocarbons but little (at most 10 percent) of ~~its~~ petrochemical capacity. The study further indicated that 35 % of world's petrochemical production could be located ~~in~~ in developing countries by 2000. By 1985, e.g. developing countries are expected to increase their share of world thermoplastics production to 20 % (compared to 6 % in 1977).

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^x Assistant Director(Plastics), National Buildings Organization, Ministry of Works & Housing, Govt. of India, MIRAN BHAWAN, NEW DELHI 110011

4. What does the future hold for the materials including plastics ? Most of the raw materials that we extract from the earth to process in our factories deplete the non-renewable resources of the earth's crust. Estimates of the likely lifetime availability (in years) of various traditional materials on the basis of known deposits, and known rates of consumption often sound very threatening. According to wellknown study prepared by the Club of Rome , there is enough iron, for example to last another 240 years at a constant rate of consumption, but only for another 93 years if the consumption continuously increases. In the case of aluminium, the corresponding estimates are 100 and 31 years and for copper 36 and 21 years.

5. On the other hand, in case of plastics materials, the phenomenon of exponential growth is actually taking place. In West Germany in 1950, the per capita consumption of plastics was 3 Kg, in 1960 it was 17 kg, and in 1970, the figure had risen to 42 kg. In the UK, the consumption of plastics had gone up in 1977 by over 20 % as against 1976; whereas during the year 1978, the consumption increased by 4.5 %. In the US, the consumption of plastics in building and construction alone rose from 1.89 million tonnes in 1975 to 2.37 million tonnes, in 1976.

6. During the period 1950-75* the rate of development of plastics production and consumption has been the highest in any industry as a whole. This was due, among others, to the low costs of its main feedstocks—crude oil and natural gas. The effective consumption of oil for petrochemical feedstock is about 6-7 % of the total world consumption (world crude oil production which was 500 million tonnes in 1950, rose to 2000 million tonnes in 1970, and is estimated to reach a level of 4000 million tonnes). Even if it is assumed that new sources of oil and gas will become available to mankind, the need to pay attention to the conservation of these valuable and finite world resources is still very great and the oil and gas used for chemical industry are much more valuable than for power generation. In view of these factors it is possible that in at least the industrially developed countries, the technical attributes of plastics materials will have an increasing importance in determining their preferential use , as opposed to naturally based materials, and consequently the rate of continuing replacement of one by the other. In developing countries, there is every prospect that the process of replacement of natural products by plastics, will move at much faster rate.

Preferential and Selective adoption of plastics:

7. The traditional materials of construction such as clay, sand, lime, bricks, cement, steel, aluminium, non-ferrous metals, timber, stone and other related manufactured products, locally and regionally available, would continue to be the primary materials for provision and upgradation of human settlements. The current concept of advanced building technology, however, emphasises the need to achieve the desired performance under conditions of use, by promoting upgradation of traditional materials, with the ~~main~~ preferential and selective adoption of new and improved materials and techniques based on plastics. During the past 25 years, major research and development efforts have been directed towards plastics in the search for economical and technically suitable materials in industrially advanced countries. Much has been studied, experimented and perfected in this direction.

8. That over 25 % of world production of plastics (45 million tonnes) goes into various building and related applications, and over 100-150 kg of different plastics go in for an average house built today in advanced countries should not surprise us.

9. The ~~xxxx~~ selective and judicious development and promotion of the use of plastics for human settlements have been found to be practical and economical in the light of user requirements and habits of the construction industry in developing countries. In other words, the development of need-based applications in plastics can have a visible impact towards provision of human settlements. Under these circumstances the following applications of plastics are considered appropriate for development and adoption. Already, applications like wood-based panel products (using UF-, PF-resin adhesive), a range of electrical fittings and fixtures, electrical wiring and cables, wall-finishes/floor-finishes based on PVC, and related thermoplastics/thermosets, have established themselves in the construction industry.

- i) Piping systems in rigid PVC, and high-density polyethylene, for cold water services, soil/waste and rainwater, underground drainage systems, electrical conduits etc;
- ii) Overhead water storage tanks in polyethylene (low-, and high-density)- rotational moulded upto 5600-gal.capacity, using cross-linked PE, having wall thickness of $\frac{3}{4}$ -in.) and glass-fibre reinforced polyester resin- in sectional designs.

- iii) Flushing cisterns in high-impact polystyrene, polypropylene and ABS;
- iv) Sanitary fittings and fixtures ; such as taps, sink and basin-wastes, waste-traps, gratings, float ball and valves, syphons for flushing cisterns, moulded in polyethylene, polypropylene, ABS and acetal resin.
- v) Building hardware such as door-handles, latches, window-stays, hinges etc; in PP, UP, Nylon, ABS and acetal resin;
- vi) Door-, and window frames and shutters, in wood-flour PVC resin-composite, structural polystyrene and PVC foams; and wood-plastics;
- vii) Partitions Panels in rigid PVC profiles;
- viii) Cladding Panels suitably designed in composites ~~existing~~ consisting of industrial wastes fly-ash (PFA), stone-dust, with polyester resin; polypropylene fibre-reinforced concrete; sandwich panels using expanded polystyrene or polyurethane foam as core materials;
- ix) Roofing sheets , using recycled plastics wastes in association with paper; jute-hessian cloth reinforced polyester resin-composite.

10. Based on the above plastics components/composites could be the nearest approach for designing building systems for provision of human settlements, both in respect of economy and upgradation of the existing systems. Traditional building materials, could be the basic materials of construction for such systems, may that be for the residential, commercial, or institutional buildings, and related services, and these to be supplemented by different plastics products.

11. Way back in the late fifties, and early sixties, there had been a craze for 'All-Plastics houses' being campaigned and promoted by major plastics manufacturing companies. Also many a time the manufacturers had been working in isolation of the users of the products in the construction industry. Exhibition structures using plastics in various forms continued to help develop a number of useful applications, so has been the case with Olympic stadia in various countries which helped promote the increased use of plastics in their design and construction. Though as structures in all-plastics, not much commercial success could be achieved due to obvious reasons of economy, and environmental, and social acceptance by the would-be inhabitants, these developmental efforts did help in promoting the cause of building-with plastics, ~~and~~

and communicate the message throughout the world.

Communications Gap :

12. Bridging the communications gap between the plastics manufacturers and the users-specifiers of the materials/products in the construction industry- the engineers, architects, builders, and plumbers-at various levels, has been a continuous process. Attempts made by the plastics industry individually and in association with professional institutes and technical colleges for engineers and architects, through lectures-demonstrations have helped promote utilization of plastics in building applications. Plastics have already identified themselves as complementary materials of construction along with wellknown materials like cement, steel, bricks and timber, whose cost of production as well as availability and desired performance have at times been questionable.

13. Performance Vs Standardisation: Standardisation of building components based on plastics is essential, more so their performance under conditions of use. This further demands material-performance, and functional requirements/performance of the design of the finished product. Since plastics materials are in variety, both in properties and performance in use, it becomes necessary to assess and evaluate their usefulness for the building component design before it is actually manufactured and put in the market for consumption. Mere copy of the traditional design of a particular building product has not helped the plastics industry, unless the design is evaluated based on the material properties of the particular plastics material. In the early days of development and manufacture of plastics building products, the manufacturers did face failures, but subsequently learnt from their experience, and have been able to perfect the products and techniques. For plastics building components, what is ^{needed} is the 'performance standards' and ^{not} the minimum standards as are normally advocated for other traditional components. Recent experience has shown that performance-in-use concept must be applied while promoting the increased use of plastics in building applications. (Examples of various products to be demonstrated)

Prospects:

14. The fact that petrochemicals-based plastics industry has been established in several countries of the world, and continuously being expanded and improved in product material and product design, it is but obvious to conclude that the use of plastics in building applications..

will grow, with the efforts being directed both by the plastics industry as well as building research and development institutions, in their search for new and improved materials of construction. With the recent oil crisis, and the campaign of energy conservation, the price-structure of plastics materials has been disturbed. Plastics materials which were henceforth called 'cheap substitutes' for traditional materials, will no longer be specified as such, but would be considered on preferential and selective basis on their own merits. Moreover the cost of production of traditional building materials has been steadily increasing, and in overall performance, technically, and even economically, plastics materials have an edge over traditional materials, including in bulk-applications, and also in specialised applications. The future growth of building applications in plastics for provision and upgradation of human settlements will certainly depend upon critical balance of price-structure, as also their use in composite with traditional materials/industrial and agricultural wastes, including use of recycled plastics wastes, and their conversion into useful building products. Already attempts made in those directions have brought forth commendable results in several countries, but these need to be exchanged on 'transfer of technology' concept.

15. It has been established beyond doubt that the energy consumption in the manufacture of traditional materials like cement, steel, aluminium is much higher as compared to those required for plastics products. For instance, TOE (Tonne of Oil Equivalent) per Km of $\frac{1}{2}$ " polypropylene pipe is only 25 % of the TOE of $\frac{1}{2}$ " steel pipe. On top of this, there is generally a saving in the energy costs of transport and installation of plastics products.

16. With the current concept for energy conservation, increase in oil price, increase in cost of production of traditional materials, and even constant shortages as against the demand, also the increase in cost of plastics materials and their conversion into products for almost every conceivable human activity, it would be desirable for various countries to keep up to date an inventory of various materials including plastics alongside, and supplement their respective applications keeping in view the local and regional requirements. In other words the trend in the next two decades may call for some sort of 'materials management' principles and their applications to shortages, and price-rise, which have become part of our daily life. It may not only be the survival of the fittest, but 'survival alongside the fittest' in respect of materials availability and use in various aspects of human life, including for provision and upgradation of human settlements, which mankind is to face.

