EXECUTIVE SUMMARY

1. Furfural is an important organic chemical, produced from agro industrial wastes and residues containing carbohydrates known as Pentosans. As no commercial synthetic routes have been found so far, all furfural manufacturing activity is based on pentosan containing residues that are obtained from the processing of various agricultural and forest products. In commercial terms, the most important intermediate derived from furfural is furfuryl alcohol. This is primarily used to make furan resins. Another chemical of importance that can be derived from furfural is tetrahydrofuran. Furfural has got other main applications like in Lube Oil refining, as bonding agent in grinding and abrasive wheels, in pharmaceuticals and in the manufacture of phenolic resins.

2. The manufacturing activity in the country started in the 70's with the Southern Agrofurane Industries Ltd. At present, in India, there are only three units manufacturing furfural. Out of these three units only one unit is manufacturing furfural using Bagasse as a raw material and the other two units are using rice husk. The following are the manufacturers of furfural in India.

	Name of the company	**Raw Material Used**
a)	Southern Agrofurane Industries Ltd. Madras (Tamil Nadu)	Bagasse
b)	Oswal Agro Furane Ltd. Ludhiana (Punjab)	Rice husk
c)	Furfur chemicals Ltd. Hyderabad (Andhra Pradesh)	Rice husk

3. The installed capacity of the industry during 1988-89 was 6400 tonnes per annum. As against this the production was about 1148 tonnes. The utilisation of capacity has been estimated at 18%.

4. Furfural is used for many applications the world over. The major applications of furfural developed in India are as follows :

— Lube oil refining

— As a bonding agent in the manufacture of grinding wheels and abrasives

— In the pharmaceutical industry

— In the manufacture of phenolic resins

Some of the major applications of furfural like furfural alcohol and tetrahydrofuran are not developed in India. The present and future demand estimates for furfural for its various applications developed in India are as follows :

Sr. No.	User Sector	Consumption in Tonnes		
		1988-89	1992-93	1999-2000
1.	Refinery	990	950	950
2.	Grinding and Abrasive Wheels	27	33	45
3.	Pharmaceuticals	75	120	235
4.	Phenolic resins	52	72	120
	Total	1104	1175	1350

Source - Field Investigations

Considering the capacity of existing units and the new capacity, mostly by way of new units likely to materialise in future, the demand and supply situation has been estimated as follows :

Year	Total Demand (Tonnes)	Total Supply (Tonnes)
1988-89	1104	1050
1992-93	1175	5000
1999-2000	1350	5000

5. From the inception of the industry, furfural manufacturing activity in the country has been dependent on foreign technology. Two manufacturers have imported plant and machinery and process know-how from internationally leading manufacturers of furfural. Furfural and Allied Products (P) Ltd. had set up a unit with a locally developed process based on rice husk, but as the recovery of furfural was very low, it proved non-viable.

The heavy dependance on borrowed technology indicates that continuous efforts towards development have not yielded the desired results. Moreover, in spite of borrowed technology the Indian industry generally has not achieved its goals. Research and Development appears to be inadequate in the furfural industry. Efforts to develop end-use applications need to be stepped up.

6. The various reasons that have been put forward for selection of foreign technology are as follows :

a) Favourable terms and conditions for technology.

b) Quality product

c) Process advantage for integrated complex

d) Assured access to latest developments at the international level.

Two companies have bought the plant and machinery from abroad, along with the process know-how.

7. There are no restrictive clauses pertaining to export.

8 The manufacturers have bought the know-how for process and plant and machinery. Support for carrying out 'Research' as such is not available. However, help for solving routine process problems and typical technical problems has been extended by the collaborators.

9. Looking at the variety of raw materials available in the country it seems that very little work has been done on furfural in India. Research on by-product recovery has not been attempted so far. However, some manufacturers have tried to manufacture furfural with a locally developed process based on rice husk. But as the recovery of furfural was very low, these attempts proved non-viable.

10. World production of furfural is wholly based on agro-industrial residues or wastes that are abundantly available in many developing countries and are often under-utilized or unexploited. Production technologies have been developed to suit the various types of raw materials found in these countries. The economics of furfural manufacture has recently been improved through the introduction of an acetic acid and formic acid recovery system, which increases the overall returns while significantly reducing pollution. Efforts have been made towards steam generation by burning the residual material from raw material processing and to achieve further economy of operations, the furfural plant is integrated into an existing industrial operation such as a sugar mill or rice mill.

11. The technology absorption efforts undertaken by companies have been at a low key. The indigenously developed process proved non-viable and the industry has been dependent on imported process know-how and plant and machinery. Efforts of an original nature in the development of product recovery, process and machinery and by-product recovery are inadequate.

12. Though the quality of furfural manufactured in India is at par with international quality standards, efforts to develop the applications of furfural for various products like furfural alcohol, furan resins and tetrahydrofuran have been lacking.

13. The furfural industry is capital intensive as the investment required in plant and machinery is very high. At present however, the industry is not making any investment to extract the maximum yield and by-product recovery. Hence, the cost of production of furfural is high. The pace of modernisation is not what it should be. It is mainly due to its poor viability on account of factors such as :

a) the scale of investment

b) the process is such that there is no by-product recovery and

c) constraints in the Indian market

14. Though the Indian industry has adopted the discontinuous process which has many disadvantages vis-a-vis the autocatalytic process, the reflections of technological achievement are seen in the quality of the product. The furfural manufactured by the Indian industry is at par with the international quality standards.

But in the Indian scene, it is deficient in terms of :

a) Maximum recovery of furfural in order to reduce the quantum of raw material used per tonne of furfural.

b) Maximum recovery of commercially important by-products like acetic acid, formic acid, methanol and acetone.

c) Profitable utilisation of the residue

d) Operational efficiency.

15. The thrust areas for indigenous technology would include :

a) Development of indigenous machinery, except for some critical equipment, equivalent to international standards.

b) The selection of suitable raw material

c) Consistency in performance and capacity utilisation

d) Achievement of high operational expertise.