

# POTENTIAL HEALTH HAZARDS OF ASBESTOS CEMENT ROOFING FOR INDIA'S POOR\*

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This paper examines the potential health effects of asbestos, particularly asbestos cement roofing, on the lives of the urban poor, comparing perspectives within the global community with that of the Indian Government.

The urban slum of New Lingarajapuram was chosen as illustrative of conditions found in slums throughout India, as the location for a survey. After presenting the context and data obtained in this survey the results are examined and wider issues surrounding asbestos use are discussed.

## Asbestos Cement Roofing – Is it Helping or Hindering the Poor?

Asbestos cement (AC) is an attractive roofing option for the poor primarily because it is cheap. This appears to be largely due to government protection of the Indian asbestos industry. AC roofing is also durable and strong which, when combined with its resistance to flammability, makes it an attractive proposition; all the more so for government authorities throughout the nation attempting to deal with the numerous and pressing issues of the poor, of which housing is merely one aspect.

It is common practice in both rural and urban areas for those living under thatched leaf roofing to replace this with corrugated AC when they can afford it. The difficulty associated with making a thatched house fully secure is a significant reason for this. Lockable doors, if affordable, cannot guarantee security requiring a family member to be present at all times in order to guard their property. This has the potential to significantly disrupt family life, employment and schooling. While this issue may be of less concern in remote rural areas, it is more pressing for people living in high-density situations such as those found in the New Lingarajapuram slum. Regardless of the issue of security, however, replacing thatched leaf roofing with corrugated AC is considered to be the “next step up” for those who are poor.

## The Case of New Lingarajapuram Slum<sup>1</sup>

In September of 1987, Bangalorean State Government officials evicted approximately 2,700 squatter families from their homes at Vasantnagar. This occurred despite several social service organizations lobbying on behalf of the inhabitants, in order that they might be able to stay put and continue to live their lives unimpeded in a place they had occupied and developed for ten to fifteen years. The issue was so contentious that the case ended up being taken to the Supreme Court. Upon receiving a verdict in their favor, Government officials went that same day to Vasantnagar, loaded families onto lorries and relocated them in the middle of the night to a new site now called New Lingarajapuram.

In order to ensure that the squatters did not attempt to return to Vasantnagar, Government officials ordered the demolition of the established places of worship among the original community. Idols from the Catholic Church were removed and impounded, and the local Imam was imprisoned. Back in New Lingarajapuram, families were assured that buses would be provided to enable children to attend their original place of schooling. This never eventuated. However, local Government officials gave each family 300 rupees, a patch of land fifteen by twenty feet, and five sheets of AC roofing. In order to qualify for this package, Government officials photographed people standing outside their houses. An unexpected problem was the fact that unscrupulous people sought to be photographed in front of the homes of others in order to receive land they were not entitled to.

Why was it that the people of Vasantnagar were transferred from one slum only to be put in another? Vasantnagar, a place where its inhabitants had established some degree of normality, social order, access to employment, markets and schooling, was located in downtown Bangalore. Simply, the squatters inhabited land that over the years was becoming increasingly desirable. At the point of eviction, Vasantnagar was prime land in a rapidly growing city with a booming economy and an increasing middle class. Land prices were soaring.

## Life in the New Lingarajapuram Slum?

Today, the slum is well established. Tiny streets are jammed packed with the homes and businesses of the inhabitants. Some dwellings are well built, reaching two or three storeys in height. Many however are overcrowded, the occupants living in very primitive conditions, without adequate sanitation or water supplies. Cooking is often carried out inside over an open fire, with little or no outside ventilation. Referred to as “the choice of the poor,” AC roofing panels are a very common sight throughout the slum.<sup>3</sup>

For the majority of people, living in the slum of New Lingarajapuram means

a daily struggle with issues resulting from the effects of poverty. For the most part, homes are overcrowded and often temporary structures. Floors are generally earthen, with some made from concrete. Houses are often built off the existing walls of adjoining properties. Many households are living in one or two small rooms. The Researcher visited a small one-room house that was occupied by a family of eight. A double bed frame took up a significant amount of space. Each night, four members of the family slept across the top of the bed on plywood sheeting, while the other four slept underneath on mats on the earth floor. Such conditions are common throughout New Lingarajapuram.

Like most people living in slums throughout the world, the inhabitants of New Lingarajapuram cook using either open wood fires, or kerosene burners. Occasionally some would cook using gas. The use of these fuels creates both a significant fire hazard and a substantial health risk to household occupants. Occupants are subjected to considerable amounts of smoke inhalation or fumes from cooking equipment. The cumulative effect of this over a period of years should not be underestimated. Occupants are also at risk of burns and scalds; injuries resulting from living in overcrowded housing, where cooking takes place indoors.

## New Lingarajapuram Slum Sample Survey<sup>4</sup>

In order to assess the condition of, and extent to which, AC roofing was a problem for those living in the New Lingarajapuram slum, the Researcher, with the help of an Indian pastor working in the area, undertook a small sample survey of fourteen houses. While the survey is of limited size, it was intended to be indicative of the population diversity found living in New Lingarajapuram. All of the houses visited had AC roofing and an absence of ceilings.

## Results of Survey

### House Rental versus Ownership

- ◆ Forty-three per cent of houses are rented as opposed to owned by their inhabitants.
- ◆ Rental prices ranged from 250-600 rupees/month (equivalent to US\$5.65-13.57 /month at 44.23:1).
- ◆ Of the six households renting accommodation, only one rented a two-roomed house, the remaining five households living in dwellings with one room.
- ◆ Two households who were renting shifted to New Lingarajapuram in order to take advantage of cheaper rents. For one household, this helped the family survive when casual employment became scarce.
- ◆ Two households who owned their properties rented out part of their homes. One lived in a two storey, four-roomed house, having built on top of the AC roof by filling in the corrugations with cement. The downstairs room was rented to a family of four for R250/month, while

ten people sleep above on the “filled in” AC roof.

### Total Occupants per Household

- ◆ The highest number of occupants living in one house was 12.
- ◆ Two houses surveyed had five children (less than 15 years of age) living there, with one of these houses being of one room in size.

### Number of Rooms per House

- ◆ Fifty per cent of houses surveyed were one-roomed dwellings.
- ◆ Just over one-third of houses surveyed contained three rooms. One of these houses contained four rooms, but had rented one of these out to another family.
- ◆ It should be noted that in all houses surveyed, all rooms are multi-purpose, being areas for cooking, eating, sleeping, etc.

### Length of Occupancy in Years

- ◆ The longest any sample household had been renting was four years.
- ◆ Half of all sample households had lived in New Lingarajapuram for six years or more, emphasizing the relative stability of the population.
- ◆ Of the 36 per cent of households who had lived in New Lingarajapuram for 16 years or more, 40 per cent had lived in the slum since its inception.

### Method of Cooking

- ◆ Thirty-six per cent of households use kerosene as their only fuel for cooking.
- ◆ Fifty per cent of households use wood as either their main source of cooking fuel, or in combination with kerosene or gas.
- ◆ Of those households exclusively cooking with wood fires, one said they only did so outside.
- ◆ Of the 14 households surveyed, four roofs were painted on the underside, three of them less than one year before surveying. Regardless of cooking fuel used, three of these houses had roofs that were discolored to varying degrees. The fourth household cooked using gas in a separate kitchen with a high cement ceiling.
- ◆ Of the ten households that had unpainted AC roofs, all of them were discolored quite badly, with four roofs in extremely poor condition.

### Household Ventilation

- ◆ Eighty-six per cent of households had either poor or no ventilation aside from their entrance doorway.
- ◆ Of the 14 households surveyed, only 14 per cent had ventilation that could be described as adequate for cooking purposes. This is usually in the form of one or more windows (generally unglazed), of approximately 200mm x 380mm in size.

\*This paper is based on *Health, Poverty and Trade Issues in Low Cost Housing Policy: the Use of Asbestos Cement Roofing in Indian Urban Slums*, a research study submitted by the author in partial fulfillment of a Master of Arts degree in August 2006.

Photographs of New Lingarajapuram Slum



Typical AC roofing in New Lingarajapuram, Bangalore. Note lack of ventilation apart from that available by using the doorway.



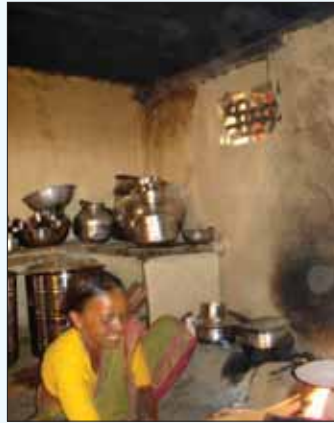
Flaking and pitted AC roofing, resulting from smoke damage. House was newly built and had been occupied for one year at the time of survey.



Smoke damaged and cracked AC roofing (same dwelling as above).



Typical exterior condition of AC roofing in New Lingarajapuram. Note the broken AC roofing sheets, low roof height and the ventilation 'window' – a typical size in the homes of New Lingarajapuram.



The effects of cooking over an open wood fire indoors. Note the ventilation 'window,' and the condition of the smoke blackened walls and AC ceiling. The occupants have lived in this dwelling for 16 years.



Pitting and smoke damage on AC roofing after long-term use (same dwelling as above).



Charred and cracked AC roofing after long-term use (same dwelling as above).



Homemade skylight cut into AC roofing, the cutting of which releases harmful chrysotile fibres into the environment. The roof has been previously painted with white emulsion paint which deteriorates rapidly, often showing signs of discolouration and mould. Note the contrast in ceiling colour when compared to white ceiling fan (top right).



Exterior AC roofing in reasonable condition. Note surface weathering.



Typical display of corrugated AC roofing for Sale, Kothanur, Greater Bangalore (Reesearcher, Supplier Survey, February 3rd, 2006).

## Kothanur Product Price and Supplier Sample Survey

During a visit to Kothanur, a rapidly growing suburban area about 13 kilometers outside of Bangalore, the Researcher conducted a small sample survey of roofing suppliers operating in the area.<sup>5</sup> The area is undergoing a building boom, resulting in the presence of many retailers within a relatively small area. It is reasonable to suggest that the findings of this sample survey would be fairly typical of retailers selling similar products elsewhere in Bangalore. In visits to six retailers of AC roofing sheets, the following information was obtained:

### Description of Products

#### Product Retailer One

As well as selling tiles and sanitary ware, the retailer sells "top quality" AC corrugated roofing (ISI Ramco) manufactured in Karnataka and Tamil Nadu. Installation of the product requires drilling holes in the roofing. The retailer was unaware that the product contained asbestos, thinking it was a composite of cement and paper.

#### Product Retailer Two

Retailer sold both AC corrugated roofing and corrugated iron, the latter in Heavy Strength (H/S) or Light Strength (L/S). The retailer explained that AC roofing is safe and causes no health problems. The retailer added that the only problem with the product can be a tendency for mould to grow on panels if they are not painted, a procedure they would recommend. An advantage of AC roofing is its strength, enabling it to be walked upon. The product is installed by drilling holes in the AC roofing in order for a U or J-bolt to be attached to the metal piping that forms the roof support.

#### Product Retailer Three

Retailer sold AC roofing as well as cement and granite aggregate. The yard was under the supervision of a young boy who telephoned his father for product prices. The boy's knowledge was understandably limited, so no further information was gained.

#### Product Retailer Four

Supplied product prices only.

#### Product Retailer Five

The retailer manufactured various fiberglass products including roofing panels. The finished product looks similar to pressed clay tiles and requires fixing to a thin metal frame. In order to match the comparison size of 10 feet x 31/2 feet, three fiberglass sections would need to be produced and joined together.

#### Product Retailer Six

The retailer sold various styles of clay tiles. These appeared to be popular in some areas of Kothanur, the Researcher observing them in-situ at the South Asia Institute for Advanced Christian Studies, and Visthar (an education and retreat centre). Prices were unable to be obtained, but it is reasonable to assume that clay tiles would be considerably more costly than AC roofing.

### Price Comparison

Supplier	Roofing product	Size:feet	Cost:rupees	Cost:pounds Sterling R78:1
Retailer One	Corrugated AC	10 x 3 1/2	R310	3.97 (US\$7.01)
		8 x 3 1/2	R255	3.27
		6 x 3 1/2	R210	2.69
Retailer Two	Corrugated AC	10 x 3 1/2	R320	4.10
		8 x 3 1/2	R255	3.27
	Corrugated Iron	10 x 3 1/2 H/S	R480	6.15
		10 x 3 1/2 L/S	R380	4.87
Retailer Three	Corrugated AC	10 x 3 1/2	R310	3.97
		8 x 3 1/2	Unavailable	N/A
Retailer Four	Corrugated AC	10 x 3 1/2	R310	3.97
		8 x 3 1/2	R270	3.46
		6 x 3 1/2	R250	3.21
Retailer Five	Fiberglass	10 x 3 1/2	R2,450	31.41

### Observations

The prices between competitors selling AC roofing are very similar.

The difference in price between AC roofing and fiberglass is extremely large with the equivalent of a 35 square foot panel costing nearly eight times as much as AC roofing. Interestingly however, while the cost of zinc coated corrugated iron is higher than that of AC roofing, the difference is more realistic (one and a half times more for heavy strength corrugated iron). That said, a price difference of this magnitude may be too great for the majority of homeowners, a factor that may at least partially account for its relative absence throughout the area. It is expected that, like fiberglass, the cost of clay tiles would be prohibitively expensive for the majority of homeowners.

### Discussion

Asbestos Cement is viewed by some in the developing world as the ideal answer to the problems associated with the provision of shelter, especially in low cost and slum contexts. However, the use of AC roofing throughout India is problematic. Of central importance is whether the use of AC in slum and low cost housing results in the environmental exposure of occupants to chrysotile asbestos. Generally, AC roofing has been regarded as posing no threat to occupant health provided the panels are well-maintained.<sup>6</sup> However, as seen in the survey, the condition of AC roofing in the New Lingarajapuram slum is poor. What impact does smoke damage have on the integrity of the product? Does the fact of damage caused by bumps and scrapes have any adverse effect on occupant health? Is the presence of cracked and broken panels indicative of the release of harmful chrysotile fibers into the household environment? Are these issues exacerbated by the degree of overcrowding and the lack of ventilation found in most dwellings surveyed in the New Lingarajapuram slum? As Rahman et al. conclude, "More information is urgently needed

Government authorities supplied essential materials for the provision of shelter to people who would otherwise have nothing. However, the health risks associated with the supply and use of AC products should also be cause for concern. Is the Indian Government supporting an industry whose products have the potential to cause large-scale health problems in the future? If so, it hinders rather than aids the development of India's most vulnerable citizens.

### Chrysotile and Asbestos Cement – What's the Problem?

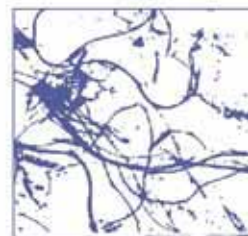
The only type of asbestos traded internationally is chrysotile. "About 90% of global asbestos use today is in AC construction materials, mainly flat sheet corrugated roofing panels and pipes."<sup>8</sup> However, like other forms of asbestos, chrysotile-based products present a significant health hazard. Chrysotile is carcinogenic. "Single fibres can cause cancerous conditions five to 30 years after exposure."<sup>9</sup> A study undertaken by the Cancer Research Institute, Chennai, concluded that three to four per cent of all lung cancer in India is asbestos-related.<sup>10</sup>

Given that chrysotile asbestos has been proven to be carcinogenic, the issue of fiber liberation from AC products in India is of concern. Not only are thousands of asbestos workers exposed to such problems, hundreds of thousands of workers in downstream industries, like construc-

about the extent of hazards represented by these products as they age and weather."<sup>7</sup>

Associated with this problem is how governments in the developing world should respond to those citizens in need of shelter, yet having limited or no resources. As with all people throughout the world, the citizens of India deserve the provision of basic human requirements, one of which is access to adequate shelter. In providing sheets of AC roofing to those people resettled in New Lingarajapuram,

### Chrysotile Asbestos – Fibre Length and Shape



Curly Chrysotile Fibres, magnification x 1400 (OEDA, 2000:2).



Straight Chrysotile Fibres in AC, magnification x 6500 (OEDA, 2002:2).

A key issue in the debate surrounding the carcinogenic potential of chrysotile centers on the issue of fiber length and shape. Short fibers are thought to penetrate the human body less than fibers that are long. Regarded as less hazardous in terms of ingestion than straight fibers, it has been claimed by pro-asbestos proponents that curly fibers are too curly to penetrate into lung tissue (OEDA, 2006). However, further studies have revealed that chrysotile fibers can be both long and straight, as evidenced above. Added to that, other studies have revealed that short fibers are able to penetrate more deeply into the lungs, therefore causing greater problems than first thought (Suzuki, GAC, 2004:27). Regardless, the length and relative dimensions of chrysotile fibers has been found to differ in AC roofing (Dyczek, 2004:8).

### Asbestos Cement - Friability

Product friability can be a significant indicator when assessing the potential for environmental exposure to chrysotile fibers from AC roofing. When not maintained in "perfect condition" AC roofing can release fibers (Vogel, European Trade Union Institute researcher, personal communication, May 31, 2006). Chrysotile fibers have been found in debris washed by rain or high pressure water jets from AC roofing in poor condition (OEDA, 2006). The condition of AC roofing is certainly an important influence on the friability of the product. Greenberg writes, "In the fresh state I have teased out the odd bundle of fibers with my thumb nail, but with well-weathered material, it has been possible to disintegrate it further manually" (personal communication, May 31, 2006).

tion, are as well. Those who work with the product, installing, cutting and disposing of it are exposed to harmful asbestos fibers. Added to that are the hundreds of thousands of end-users that are exposed to AC products on a daily basis in their homes, schools and workplaces. If products like AC roofing are regularly monitored and kept in good condition, the threat they pose to end-users is reduced. If this is not the case, however, the prevailing scientific and medical opinion is that it should be removed and disposed of; a difficult and complex job requiring specialist expertise and large expense.<sup>11</sup>

#### Research Findings

Despite a lack of resources precluding an exhaustive investigation of the issues raised in this study, and the fact that practicalities prevent the provision of much of the corroborating evidence in this chapter, the findings of this study provide indicative support for the following hypotheses:

**1 Exposed and damaged AC roofing exposes slum dwellers to adverse health effects caused by the inhalation of chrysotile fibers. This can result in debilitating illnesses, prolonged suffering and death.**

AC has been proven to be friable, increasing the possibility of it releasing harmful chrysotile fibers. Added to that, AC roofing becomes increasingly brittle with age, regardless of how well it is maintained. The subsequent exposure to asbestos fibers has the potential to affect the thousands of occupants living in the New Lingarajapuram slum, as well as the millions of people living in similar conditions throughout India. The AC roofing assessed during the New Lingarajapuram Sample Survey was generally in poor condition and continuing to deteriorate, therefore increasing the likelihood that harmful chrysotile fibers

will be released into the surrounding environment. Dopp et al. write, "Indoor air can become contaminated with fibers released from building materials, especially if they are damaged or crumbling."<sup>12</sup> Added to that, if acid rain is, or became, a problem in the rapidly expanding and heavily polluted city of Bangalore, this would further threaten the durability of AC roofing and subsequently increase the potential for release of chrysotile fibers.<sup>13</sup>

**2 Cooking indoors over wood fires damages AC roofing, increasing the**

**likelihood of potentially harmful chrysotile fibers being released into the surrounding environment, thus threatening the health of the occupants.**

It is probable that smoke and heat cause most damage to the underside of AC roofing in slum contexts. This is a consequence of cooking inside over open fires in small dwellings generally having little or no ventilation (see photographs). Visits to various dwellings in the New Lingarajapuram slum as part of the Site Survey revealed that the vast majority of AC roofing was in poor condition. Over time, the crusting of smoke soot on the underside of the roof solidifies and eventually flakes off, appearing to pit and damage the AC. This increases the likelihood that harmful chrysotile fibers are released into the surrounding environment. In addition, the survey found many AC panels that had been cracked or broken. It is possible that this premature deterioration has been caused by both smoke and heat damage. Exposure to such elements is likely to make the product increasingly brittle and consequently more friable. Added to that is the fact that when AC roofing is cracked or broken, harmful chrysotile fibers are released in significant numbers due to the pull out effect as discussed by Dyczek.<sup>14</sup> Importantly, the lack of ventilation prevalent in most dwellings means that any chrysotile fibers released as a result of damaged roofing are largely trapped inside the dwelling, thereby increasing the chance of occupant exposure and inhalation. The fact that most dwellings are small and overcrowded further exacerbates the potential of this problem.

The Researcher notes that where cook-

ing had been conducted indoors over kerosene in New Lingarajapuram, the AC roofing was still in a state of deterioration. Even those roofs that had been painted on the underside had become discolored, with a cracked panel being evident in one dwelling. It is unknown just how much of an adverse effect the indoor use of kerosene cookers has on AC roofing. This is an area that may warrant further investigation.

**3 The inevitable bumps and scrapes to AC roofing, a consequence of living in small and overcrowded slum dwellings often with very low ceilings, will result in the release of harmful chrysotile fibers into the surrounding environment, thus threatening the health of the occupants.**

The friability of AC roofing has been clearly established. This process inevitably speeds up when panels are already in a state of deterioration, as found in the vast majority of dwellings throughout New Lingarajapuram. In contrast to the majority of houses throughout the developed world, e.g. in Australia, New Zealand and the United Kingdom, all houses sampled had no ceiling beneath the underside of the AC roofing. Thus, chrysotile fibers are released directly into the living space. In a context like the New Lingarajapuram slum, both the prevalence of overcrowding and size of dwelling combine to increase the chance that exposed AC roofing will get damaged or scraped as a result of the activities of the occupants. The low roof height of many dwellings further exacerbates this likelihood. Added to that, the lack of ventilation effectively traps released chrysotile fibers within the dwelling.



#### What about damaged AC Sheets?

The risk of asbestos dust release from AC products subjected to breaking, cracking or spilling is high. Studying the risk of asbestos release based on analysis of AC roofing sheets in Poland, Dyczek makes the following observations:

- The asbestos fibres are sticking out due to the pull out effect. This occurs when composite materials that are reinforced by short fibers are fractured or cracked, as in the case of AC (2004:8).
- The fibres observed differed in both length and relative dimensions. "Any mechanical influence on these protruding fibres may produce a large number of asbestos dust particles" (ibid.).
- "From one asbestos fibre, protruding as we see in Photo 12 [sic], we may get hundreds or thousands of respirable asbestos fibres; it is only a question of even feeble mechanical action or other tension. For example, movement caused by thermal expansion could be sufficient" (ibid.).



Asbestos Fibres on a Broken AC Sheet. SEM magnification 200x (Dyczek, 2004:8).

#### 4 Those living in slum contexts similar to New Lingarajapuram are least equipped to deal with the potential health issues arising from exposure to AC roofing.

People living in slums like New Lingarajapuram face a daily struggle for survival. The reality of poverty confronts this sector of society in ways few other people experience. While New Lingarajapuram displays occasional signs to the contrary, the vast majority of occupants struggle to achieve the most basic level of subsistence. Issues common to most people enduring extreme poverty are prevalent within the slum: lack of food, malnutrition, diseases associated with inadequate water and sanitation facilities, little access to health care, indebtedness to moneylenders and landlords, and un and under-employment. These issues result in an existence marked by insecurity, vulnerability and uncertainty.

As displayed in the New Lingarajapuram slum, those facing the reality of poverty lack the resources required to address their situation. The reality is that people living in New Lingarajapuram have many things to worry about other than the potential health risk caused by living under AC roofing. Added to that, there is a general lack of knowledge concerning the carcinogenic potential of chrysotile-based products throughout most sectors of Indian society, including consumers, retailers and policy-makers.<sup>15</sup> This may even extend to some within the medical sector: "I reckon that the actual carcinogenic fibre of asbestos probably does not exist here in contrast to that which exists in Belfast, UK..."<sup>16</sup>

Given the lack of knowledge and confusion about chrysotile throughout India, the poor are least likely to be informed about such issues. However, even if this were not the case, the poor are generally least equipped to be able to mobilize as a group in order to articulate their concerns. This means that they are least likely to be heard and responded to in ways appropriate to their situation, making it almost impossible for them to change their reality. Policy-makers are unlikely to listen to the concerns of the poor unless they are forced to do so, or others intervene on their behalf. The pervasiveness of the caste system within India further exacerbates this problem.

#### 5 The promotion and use of AC has significant disadvantages for the developing nation of India, outweighing any advantages to be gained from use of the product.

The reasons for this are as follows:

a) Although encouraging economic growth and prosperity, the support given to the AC industry by the Indian Government has the potential to create large and complex problems:

While the industry provides a sig-

nificant engine of growth, providing revenue and employment, costs resulting from the adverse effects of AC products have the potential to far outweigh any gains the industry may bring to the Indian economy. While providing shelter to those in need at an affordable price, product friability means that the potential for adverse health effects, resulting from environmental exposure to AC roofing, is likely to be high. Further research and survey data would reveal the actual extent of this problem. However, asbestos-related diseases resulting from exposure to chrysotile fibers have very long latency periods, generally ranging from 10-40 years. Even among the relatively stable population in New Lingarajapuram, symptoms may not be observable for some years yet. Diagnosis of such diseases can prove to be difficult. Due to a lack of accurate data concerning those suffering from, or at risk of, asbestos-related diseases in India, the country is dealing with a potentially large problem with significant and far-reaching consequences, yet it is doing so from the basis of relative ignorance.<sup>17</sup> Even if the proportion of those suffering from such diseases in India was low, the actual numbers affected could be large. The subsequent social and financial commitment required by State and/or Federal Government to address these issues has the potential to divert attention and funding from other development priorities.

b) The promotion and use of AC roofing has potentially large and unknown costs for India, both in social and financial terms:

Diseases resulting from exposure to chrysotile can be fatal or seriously debilitating. Often victims may be the only breadwinners, leaving dependents facing a precarious and uncertain future. This is exacerbated for those families in debt and/or living in rented accommodation, both common realities for the poor. The threat to both social and economic cohesion within communities is obvious and potentially far-reaching.

c) The promotion and use of AC products within India is a threat to child health:

It is probable that if exposed to asbestos, children will have an increased susceptibility to asbestos-related diseases due to the fact that their bodies are still developing. "Young body tissue is growing and may be more susceptible to carcinogens."<sup>18</sup> "Because of the rapid increase of risk with time, the lifetime effect of exposure in childhood is likely to be much greater than if exposure begins in adulthood."<sup>19</sup> "Asbestos has been found in the lungs of very young children (three weeks-25 months) when examined after they had died."<sup>20</sup> In a context like New Lingarajapuram, where children are living in overcrowded and poorly ventilated environments under increasingly

friable AC roofing, the threat to child health is likely to be high.

d) The promotion and use of AC products creates an obvious and proven threat to worker safety and health:

This is evidenced in the adverse impact on worker health resulting from exposure to asbestos during mining and manufacture.<sup>21</sup> It is also evidenced in the experiences of those working in the Indian ship-breaking industry, where large amounts of asbestos are required to be disposed of by workers operating in dangerous and unprotected conditions.

e) The promotion and use of AC products results in significant environmental degradation both within and beyond India:

Industries involved in the mining of asbestos have dumped asbestos waste in ways that are adverse to environmental sustainability.<sup>22</sup> The cost to present and future generations is high. Such practices threaten those living near mines and dumping sites. "Because of their small size, chrysotile fibers may be transported from their place of origin by wind and water."<sup>23</sup> The dumping of asbestos waste also adversely alters the ecology of the surrounding plant and animal life.<sup>24</sup> In the case of those involved in India's ship-breaking industry, asbestos waste has been reported to have been dumped in the sea. Such behavior has a significant impact on the seawater environment.

f) The promotion and use of AC products encourages the presence of toxic businesses in India:

Businesses focused on increasing profitability can be tempted to adopt substandard and unethical practices. This includes operating in settings where regulations concerning wage rates, worker health and safety, and environmental protection are non-existent, lax or unenforced. Worldwide, the asbestos industry has a history and reputation for operating in such a manner.<sup>25</sup> Industry observers have for some years documented the migration of toxic industries, including the asbestos industry, from countries in the developed world to developing countries eager to generate economic growth and prosperity. The migration to, and subsequent growth of, the asbestos industry within developing nations like India, is significant and mirrors the migration of other such industries with similar adverse health effects, e.g. the tobacco industry.<sup>26</sup> In this regard, the costs resulting from the presence of such industries outweigh any benefits that might be gained from their activities.

g) The promotion and use of AC products has the potential to expose the Indian asbestos industry to future litigation, by claimants seeking compensation for asbestos-related diseases incurred as a result of occupational and environmental exposure:

Companies in the developed world that have previously mined, manufactured or used asbestos-based products, such as James Hardie, Turner and Newall, Halliburton etc, have been subjected to extensive litigation in recent years.<sup>27</sup> Regardless of the legitimacy of these claims, the experience of countries like the United States demonstrates that this is an extremely costly business, tying up sections of the judicial system for years.<sup>28</sup> Many companies facing such claims file for bankruptcy, although some do so purely to avoid paying huge amounts of compensation, e.g. Halliburton and Owens-Corning.<sup>29</sup> Others try to avoid their legal and moral responsibilities through relocation, as exemplified by the move of the parent company of James Hardie to the Netherlands, "... a country that does not have a treaty for the enforcement of a legal decision taken in Australia ..."<sup>30</sup>

Of particular interest to this study is the fact that environmental exposures are increasingly being recognized as worthy of compensation in case law.<sup>31</sup> This could have enormous implications for a country such as India, where the use of AC roofing is so widespread. Also of importance is the fact that there is increasing reliance on the State to pay for compensation and health care, when companies default.<sup>32</sup> In consequence, this diverts significant funds from other important social issues, stalling the development and growth of the affected country.

The extent and success of asbestos litigation is likely to vary greatly between countries in the developed and developing world. However, in the developing nation of India, litigation against the asbestos industry has resulted in compensation for workers who have contracted asbestos-related diseases.<sup>33</sup> While the current numbers of claims and workers benefiting from compensation are very low, this may change in future years resulting in great cost to the Indian asbestos industry and/or Government.

h) The promotion and use of AC products throughout India presents substantial problems in the event of disaster:

Disaster events demolish houses, schools and businesses, a fact dramatically evidenced throughout much of Tamil Nadu in the tsunami of December 2004. The evidence is clear that broken AC roofing releases significant amounts of chrysotile fiber into the environment. Disaster events of such magnitude could result in substantial exposure to chrysotile, subsequently increasing the potential for adverse health effects. This has far-reaching implications for both survivors and rescue workers alike.<sup>34</sup> Added to that, is the prevalence of asbestos-laden debris resulting from a disaster event. Such debris needs to be carefully disposed of in designated dumping sites, something that is

unlikely to happen in urgent clean-up operations where lives and livelihoods are at stake. The adverse effect on the surrounding environment from asbestos-laden debris is also high.<sup>35</sup>

i) The promotion and use of AC products within India risks polarizing international opinion, impacting negatively on India's image:

Many developed and developing countries have banned the use of all forms of asbestos. The approach of India could send a message to other countries that the nation is unconcerned about human rights and environmental issues. This could have an adverse effect on India's credibility, and its desire to become more prosperous and play a more significant role within an increasingly globalized world. For this reason, it is important that policy-makers, and potential investors in the industry, are fully apprised of the issues surrounding continued asbestos use.

#### Implications of this Study for Government Policy and Future Action

The problems associated with the continued use of AC roofing throughout India are preventable. As such, the Indian Government is faced with a choice as to how best to respond to those issues surrounding the continued use of AC. A considered response is required in order to prevent ill-considered and hasty ad hoc reactions that could adversely affect the development of the poor. Central to this decision is whether the advantages of continued use outweigh the disadvantages. If this proves to be the case, the status quo can be adhered to. If not, however, some form of action is required, the extent and priority of which needs to be determined given those other development issues currently demanding attention throughout India.

#### So What are the Alternatives?

**Possible responses by State and Federal Government include the following alternatives:**

1 Ban the import of chrysotile and manufacture of chrysotile products, as many other developed and developing countries have done.

2 Remove and replace AC roofing in slums like New Lingarajapuram. This would be a difficult and costly exercise, the scale of which makes this goal virtually impossible to achieve. If such a policy was to be pursued, however, at whose expense should this be? Government funding would need to be diverted from other development initiatives aimed at alleviating the plight of India's poor. Those living in slums are least well placed to be able to meet the costs of conversion. Landlords would be likely to increase rental prices in order to recover their costs, further marginalizing those dependent on rental accommodation. Furthermore, the removal and disposal of AC roofing requires highly equipped, specialist teams. Finally, even if AC roofing were to be replaced, what gains could occupants expect as a result?

#### AC Roofing – Options and Alternatives

Some possibilities include:

*Thatched roofing from coconut leaves or similar:* As has been used in Visthar, an education and retreat centre near Bangalore, which has adopted environmentally sustainable building practices (Selvaraj, Director of Visthar, personal communication and site visit, February 1, 2006.).

*Galvanized corrugated iron:* This option has the disadvantage of releasing heat into those dwellings without a ceiling. It would also be noisy during the wet season. However, it would be possible to safely harvest rainwater for drinking from this product and it is relatively cost competitive.

*Clay tiles*

*Fiberglass*

*Pressed metal tiles (NEDLAC, 2002:66).*

*Bitumen based corrugated roofing:* A short-term solution as seen in Internally Displaced Persons camps resulting from the 2004 tsunami in Tamil Nadu. The product also has a high degree of flammability (Site visit, January 22, 2006).

*Cellulose fiber-cement:* eg: sisal fiber corrugated roofing (NEDLAC, 2002:62:

Dhillon, The Tribune, May 9, 2002: Online).

*Micro-concrete roofing tiles:* A durable product using low-cost technology that is easily transferable to developing country situations and initiatives (Ruskulis, 1996).

*Refurbish existing AC roofing with an encapsulation process:* An option promoted in the developed world, this eliminates the need to dispose of existing AC roofing (Aranovus, April 5, 2006 and March 17, 2005).

NB. Further investigation into the relative merits of these and other options is required.

3 Leave AC roofing in good condition in situ, implementing regular monitoring in accordance with dominant medical and scientific opinion. This would be a complicated and costly task. Added to that, the condition of AC roofing present in other settings, such as businesses, schools, and rural dwellings, also requires regular monitoring – again an expensive proposition.

4 Strengthen the regulatory system to ensure the controlled use of all chrysotile-containing materials.<sup>36</sup>

5 Ensure that appropriate work practices are maintained for those working with AC roofing.

6 Create a national database registering victims, and those most at risk, of asbestos-related diseases. Added to this, detailing deaths caused by asbestos-related diseases in mortality statistics would further enable the accurate monitoring of the asbestos problem within India.

7 Implement an education programme outlining the potential health risks associated with AC roofing. This would be most effective if relevant information was tailored to the needs of specific groups, e.g. slum dwellers with low or no literacy, product workers, retailers, the medical profession, policy-makers, etc.

8 Ensure asbestos producers and manufacturers operating within and outside of India fund research into asbestos-related illnesses and treatment options. This could prove to be cheaper for the industry than the potential and ongoing costs associated with litigation, compensation and health care.

9 Review the current subsidization of the Indian AC industry. The lifting of subsidies would create an environment where alternative roofing options could compete fairly with AC. However, if the Indian Government wanted to

promote substitute options, it could transfer those subsidies currently given to the AC industry to manufacturers of safer alternatives. It could also use those subsidies to assist the AC industry to transfer from asbestos to non-asbestos fiber-cement production, as has been done in Lithuania and South Africa.<sup>37</sup>

10 Investigate the viability of alternative roofing options, providing assistance with research and development for manufacturers (see inset).

Should the Indian Government take remedial action in response to the issues raised by the asbestos debate, the latter options (numbers 4-10) could provide useful and cost effective interim solutions while further research is undertaken.

#### Consequences and Implications of Continued Use of AC in India

India faces many difficulties should negative health effects manifest themselves as a result of environmental exposure to chrysotile asbestos in AC roofing. The experience of many countries is that the consequences of asbestos exposure are far-reaching and costly, both socially and economically.

At the centre of this study have been the people of New Lingarajapuram slum, who live in homes with AC roofing and, occasionally, walls. The people within this community are representative of the millions living in India, and other countries in the developing world, using AC for the provision of shelter. Is the use of AC roofing throughout and beyond New Lingarajapuram killing the very people it was designed to protect? In order to consider the issues raised in this study, it is necessary to further investigate how much of a problem asbestos-related diseases are in New Lingarajapuram and beyond. This will not be an easy exercise due to difficulties in diagnosis and the length of latency before asbestos-related diseases are able to be identified.

India is keen to develop a stable and growing economy so that all of its citizens might prosper. In doing so, however, they risk supporting the development of an industry often regarded as toxic, while ignoring or being naive to the effects of doing so. Ignoring the health problems associated with asbestos use has implications for how the Indian Government treats its citizens, especially those who are poor and vulnerable. Having no developed structure of social welfare, the Indian Government will have to decide how to respond to the issues generated by the asbestos debate, given that it faces many pressing demands on its resources.

