# GAS TROUBLE
# Air Quality in SIPCOT, Cuddalore


**SIPCOT Area Community Environmental Monitors**
G. K. Amrithalingam; T. Arulselvam; G. Gowri; Nityanand Jayaraman; J. Parasuraman; G. Parthiban; S. Pugazhenthi; S. Ramanathan; Shweta Narayan; P. Sivakumar; S. Sivashankar

A report of the Cuddalore District Consumer Organisation, FEDCOT, Global Community Monitor and The Other Media

**September 2004**

**The SIPCOT Area Community Environmental Monitors acknowledge the contributions and encouragement of the following individuals and organisations:**

Denny Larson, Global Community Monitor
M. Nizamudeen, FEDCOT
Madhumita Dutta, The Other Media
Dr. Mark Chernaik, Staff Scientist, E – LAW U.S.
Meche Lu, Staff Scientist, E – LAW U.S.
Ms. Wilma Subra
Groundwork - South Africa,
Global Green Grants, USA
Mitch Kapor Foundation, USA
Courtney's Fund
Richard and Rhoda Goldman Foundation

Cover Photo: Denny Larson, 2004
Translation in Tamil: Srinivasan

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# *Foreword*

The ambient air samples collected by the SIPCOT Area Community Environmental Monitors (SACEM) in the residential areas surrounding a number of chemical manufacturing facilities in the Cuddalore industrial estate documented extremely elevated levels of a large number of toxic chemicals in the air breathed by community members. The concentrations of the chemicals are at unacceptable levels, exceed ambient air standards, and the cumulative impacts of the large number of chemicals pose unacceptable health threats to the communities living in proximity to the industrial facilities. The toxic chemicals detected in the ambient air include several known and suspected carcinogens, and chemicals that cause birth defects, respiratory irritation, impacts on the central nervous system.

The ambient air samples collected by the SIPCOT Area Community Environmental Monitors (SACEM) seen in conjunction with the Chemical Odour Incidents data demonstrates an urgent need for an aggressive toxics use and release reduction program specifically aimed at reducing toxic chemicals released into the air by limiting fugitive emissions and accidental releases. To further document the emissions and sources of emissions and to follow the progress of the proposed toxics reduction program, a comprehensive ambient air monitoring program, covering all classes of chemicals being released, should be established immediately. The health impacts associated with the air emissions should be documented and addressed through an environmental health monitoring and intervention program.

Ms. Wilma Subra
Louisiana, USA

*Ms. Subra is an accomplished and experienced environmental scientist who has assisted more than 500 community groups with technical expertise on pollution and pollution monitoring. She has worked on the Love Canal case in New York, and has been engaged in environmental justice struggles in the toxic petrochemical corridor in Louisiana, USA. She is the recipient of the 1999 MacArthur Foundation Genius Award.*

## Executive Summary:

Residents living in and around the SIPCOT chemical industrial estate, Cuddalore, have complained of day-long intense chemical odours for nearly two decades. According to them, the odours are indicative of the chemical pollution in the air they breathe, and are the cause for many of the health disorders they suffer from. Women residents have highlighted the high rates of morbidity among the region's children. Anecdotal evidence gives cause for concern that children in the SIPCOT area may be suffering from physical, mental and sexual development deficits. The credibility of such anecdotes is strengthened when one considers the fact that pregnant women and children tend to spend all their time within the polluted environment of SIPCOT.

Till date, the regulatory authorities have failed to take the complaints seriously. As a result, no information exists regarding the nature and levels of toxic gases in the air in the residential areas in and around SIPCOT. Neither have the regulators conducted any health studies to investigate the nature of health problems and their probable causes. Needless to say, no action has been taken to prevent local communities from being exposed to industrial chemicals through the air, water and food consumed by them.

It is a fact that chemical odours are treated as an important indicator for pollution, and that the environmental regulators in Japan, New Zealand, Germany and the United Kingdom have developed techniques to monitor them.[1]

From March to June 2004, SIPCOT Area Community Environmental Monitors (SACEM) – a team of individuals from three villages in SIPCOT -- sampled five instances of chemical odour in and around SIPCOT industrial complex, Cuddalore. The samples were analysed for 67 volatile organic compounds (VOCs) and 20 sulphur compounds.

The results of the five samples are summarized below:

1. A total of 22 toxic chemicals were detected.

2. At least 13 of the chemicals detected are used as raw material in one or more SIPCOT industries.

3. Out of the 22 chemicals found, 17 target the eyes; 18 target the respiratory system; 13 target the Central Nervous System; 14 target the skin; 8 target the liver; 6 target the Cardiovascular system; 6 target the kidneys; 4 target the blood system; 1 targets the reproductive system.

4. Eight of the 22 chemicals are known to cause cancer in animals and/or humans. Two are known human carcinogens; 6 are known animal carcinogens, and all are known or potential occupational carcinogens.

5. A number of chemicals are also attributed with causing birth defects, central nervous system effects and respiratory disorders.

6. At least 14 out of 22 chemicals violate the US EPA Region 6 Effects Screening Levels for residential air.
    - 1,2-Dichloroethane, taken downwind of Tagros Chemicals, exceeded the screening levels by a factor of 22,973.
    - Chloroform was above Region 6 Screening Levels by a factor of 5119 in the sample taken downwind of Shasun Chemicals.
    - Methylene Chloride and Hydrogen Sulphide were found in the sample taken downwind of CUSECS No. 5 at levels 905 and 874 times respectively above the Effects Screening Levels.

- Trichloroethene and Acrolein in the samples taken downwind of Asian Paints exceeded EPA Region 6 levels by factors of 127 and 320 respectively.

Four out of the above six chemicals, with the exception of Hydrogen Sulphide and Acrolein, are known or suspected human or animal carcinogens.

7. Because the high levels of chemicals were recorded outside the factories in public thoroughfare, it can be safely assumed that the levels of the chemicals closer to their sources inside the factory are a cause of concern in terms of worker health.

8. No ambient air quality standards exist for any of the chemicals tested. Only 3 out of 20 sulphur compounds, and 18 out of 67 VOCs tested for even have occupational levels set under the Schedule 2 of the Factories Act, 1948. Of the 22 chemicals found in the ambient air outside the factories, only 12 have occupational standards set under the Act.

**Based on the findings of the sampling exercise and the information about the chemicals, SIPCOT Area Community Environmental Monitors demands the following to address the problem:**

1. Initiate continuous and long-term monitoring of emissions in SIPCOT industrial area Cuddalore, including for toxic gases such as VOCs and sulphur compounds, and publish the results periodically.

2. Use the data to apprehend polluters and take corrective action to bring levels of toxic gases to below detection limits in residential areas.

3. Conduct and make public company-specific audits, mass balance exercises, and toxic release reduction plans to pinpoint and fix leaks, fugitive emissions and total losses to the environment of chemicals used or generated in the process.

4. Provide for long-term health monitoring by initiating health studies among the residents of villages and workers in and around SIPCOT, Cuddalore.

5. Set up specialized health care infrastructure at polluters' cost to cater to pollution-impacted SIPCOT residents and factory workers.

6. Constitute a local area committee comprising Panchayat members, representatives of women's Self Help Groups, NGO nominees, to monitor and report pollution, and oversee the running of the health care infrastructure.

7. Initiate a health-based national standards setting process for toxic gases in air, involving public interest scientists and NGOs. The process should be aimed at limiting levels of toxic gases in ambient air in residential areas to below detection limits, and setting stringent health-based levels for occupational exposure.

## Background – SIPCOT and Pollution

The State Industries Promotion Corporation of Tamilnadu (SIPCOT) chemical industrial estate is located 8 km from Cuddalore on the seaward side of the Cuddalore-Chidambaram Road. The estate stretches from Pachaiyankuppam in the North to Semmankuppam panchayat in the South. Set up in 1982, the first phase of the industrial complex spreads over 200 hectares (519 acres) and is set up to house 53 units. Phase II will cover 88 hectares (200 acres).

At least 10 villages lie within or in the vicinity of the industrial complex. Some of the villages, like Pachaiyankuppam, Eachangadu and Sangolikuppam are surrounded by industries on three sides, and bound by the river Uppanar on the fourth. At least 20,000 people are estimated to be living in the potential impact zone of SIPCOT. A bulk of the workforce in the SIPCOT industries is daily wage or contract labourers who earn about Rs. 50 per day.

SIPCOT invites industries with the promise of infrastructure and subsidies. The plots are priced at Rs. 14 lakhs per acre, and entrepreneurs are entitled to cash subsidies. SIPCOT in Cuddalore also provides a separate electrical substation and "abundant" water to the industries.[2] While much effort has gone to ensure unhindered functioning of the industries, SIPCOT has till date failed to provide adequate or appropriate facilities to ensure that the industrial operations, effluents, air emissions and solid waste do not pollute the environment or harm human health.

Varying figures place the number of functional units in Phase I of the industrial estate at between 26 and 29. A few companies such as EID Parry, Elf Atofina, Vanavil Dyes and Bayer operate outside the SIPCOT limits but in the vicinity of the Estate. The companies in and around SIPCOT manufacture pesticides and intermediates, pharmaceuticals and intermediates, chemicals, plastics and plastic additives, dyes and intermediates and textiles. According to 1999 data from the Tamil Nadu Pollution Control Board, SIPCOT industries use more than 100 chemicals in their daily operations.[3]

Residents of SIPCOT area have complained about chemical odour incidents, widespread and persistent air and water pollution, and related health effects particularly on children. Until 1998, no data was available on air pollution in SIPCOT. In July 1998, an Ambient Air Quality Monitoring Station was set up to monitor basic air parameters such as SPM, RPM, Sox and NOx. The system operated only until November 2001. However, the data is not published or made available to public. Neither does it report on the levels of toxic gases.

The Indian People's Tribunal on Environment and Human Rights chaired by Justice (Retd) J. Kanakaraj of the Madras High Court reports that SIPCOT villagers "liken the atmosphere in SIPCOT to a slow-motion Bhopal, with gas leaks and routine air emissions that debilitate the local residents. "In Bhopal, people died on a single day. Here we die every day," says Semmankuppam president P.R.V. Jagannathan.[4]

**Table 1: Commonly reported health problems by the residents of SIPCOT Cuddalore**

| | | |
|---|---|---|
| Watering of eyes | Vomiting | Chest pain |
| Headache | Dizziness | Throat irritation |
| Nausea | Breathlessness, Suffocation | Stomach churning |
| Cold and cough | Skin diseases | Intelligence deficits |
| Delayed puberty | Physical development deficits | infertility |

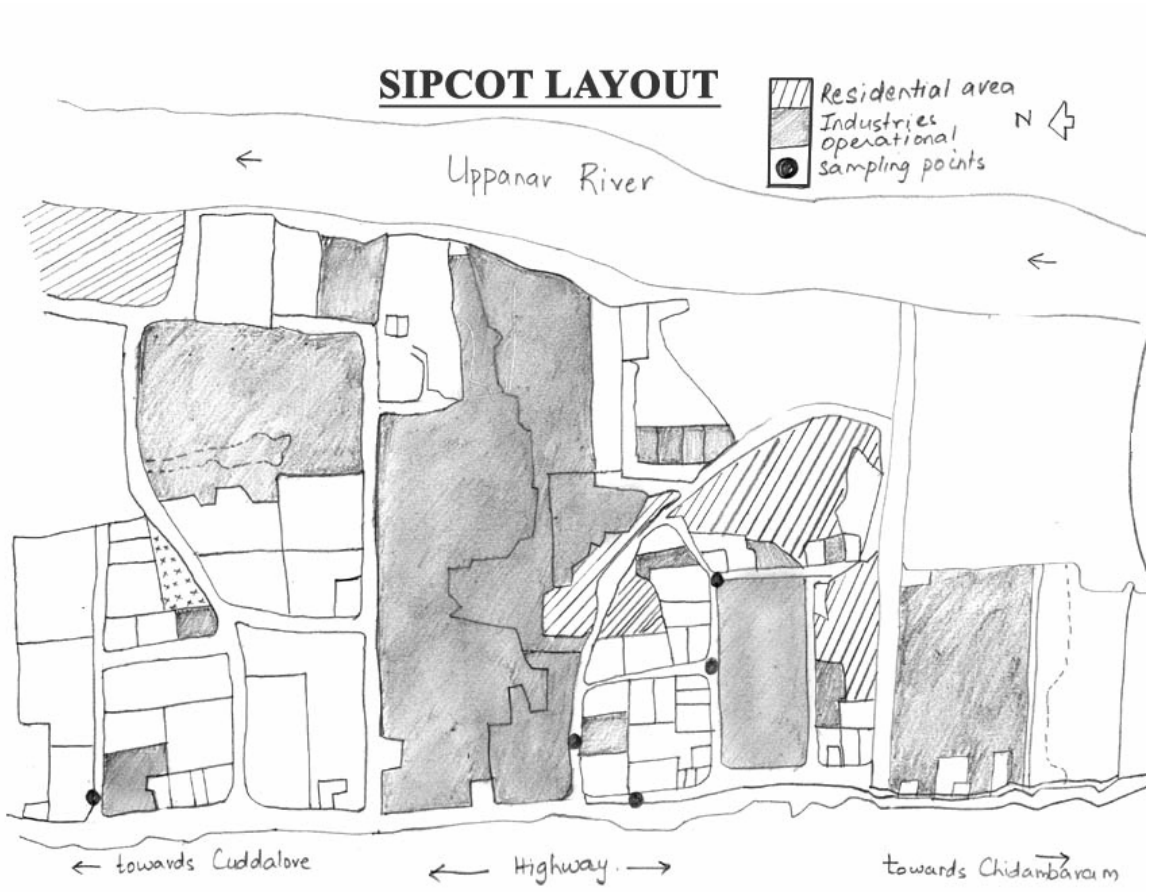
Residents' complaints about chemical odours have failed to rouse the authorities. Women residents describe a host of symptoms and health effects that people there suffer from. [See Table 1 above] However, no meaningful action has been taken by the authorities. The Pollution Control Board perceives odour as a nuisance rather than an indication of chemical pollution, and has failed to make any links between the villagers' complaints and industrial pollution. Although

the authorities routinely attempt to downplay the problem, they have till date offered no scientific evidence that contradicts villagers' claims that the SIPCOT air is polluted or that their health effects are caused by pollution.

Indeed, many of the chemicals used in the industries not only have distinctive odours, but also exert many of the health effects described by the villagers. (See Table 4)

A chemical odour incident monitoring study[5] carried out by SIPCOT Area Community Environmental Monitors over a 14-week period from April to July 2004 reported:

- 283 different chemical odour incidents, of which 223 were intense or serious incidents.
- 36 kinds of chemical odours.
- 30 immediate health symptoms related to the chemical odours.
- That the smells were prevalent throughout the day, but tended to intensify and become more frequent in the evening.




**Map not to Scale**

## Methodology and Analysis:

To investigate the chemicals behind the commonly reported chemical odour incidents, SACEM adopted a community-based air sampling device called the “Bucket” to capture air samples during intense odour incidents. The bucket is a sturdy, easy-to-use plastic container fitted with a special “Tedlar” plastic bag to capture “grab” samples.

Samples were taken by monitors trained in pollution and odour incident monitoring and air-sampling using the bucket. The latter training emphasised sampling techniques as well as standardised Quality Control and Quality Assurance procedures approved by the US EPA. Monitors practiced by taking dummy samples in the field, and subsequently kept their skills current by engaging in regular pollution patrol exercises in the industrial estate.

Monitors are adept at sampling odour incident without allowing the sample to be incidentally contaminated by non-industrial sources such as cigarette smoke or vehicular emissions. Details such as wind direction, sampling location with respect to known or potential industrial sources, time and duration of sampling, and other observable conditions such as type of smell and visible pollution at the time of sampling were recorded in a “Chain of Custody” form. All samples were taken outside industries in public thoroughfares and near residential areas.

Aside from the bucket samples, the monitors kept note of chemical odour incidents on a daily basis. The bucket method uses “grab” sampling, a well-established environmental monitoring technique.

Samples contained in the Tedlar bag are detached and sent to Columbia Analytical Services – a US EPA accredited laboratory in California, USA. The lab analyses the samples for 67 VOCs and 20 sulphur compounds. Bucket samples cannot be analysed for particulate matter, heavy metals or for toxins such as dioxins that attach themselves to particulate matter. Neither can the samples be used to measure acid rain or radiation.

The sampling device and methodology, and analytical procedures adhere to US EPA norms. The lab uses the USEPA Modified TO15 Method using a GCMS to screen and quantify VOCs. For reduced sulphur gases like hydrogen sulphide and methyl mercaptan, US EPA Modified Method TO 16 using a gas chromatograph fitted with a Sulphur Chemiluminescence detector is used.

Some samples reached the laboratory outside the prescribed holding time of 72 hours from time of sampling. Because some of the chemicals are prone to degrading below detection levels if the analyses are conducted after the holding time, the levels and chemicals found represent a conservative estimate of what was originally present in the air sample.

## Interpretation of Data:

Analytical data is assessed by comparison with established benchmarks or standards. In India, ambient air quality standards do not cover toxic gases such as VOCs and sulphur compounds. Even occupational standards are extremely limited despite the fact that many of the VOCs and sulphur compounds are chemicals of occupational concern. Of the 67 VOCs and 20 sulphur compounds tested for, Schedule 2 of the Factories Act, 1948, contains occupational standards for only 18 and 3 chemicals respectively.

Community air monitoring teams in South Africa, USA and the Philippines that use the Bucket routinely compare their analyses with the following screening levels or standards from the US. Many Screening Levels and standards account for the duration of exposures.

On the face of it, it may seem that the results of the grab sample (a 3-minute sample) may not be comparable with 1, 8 or 24-hour levels. However, given that the bucket analyses provides an indication of the chemicals contained in any intense odour incident, and given that the frequency and intensity of odour incidents is also recorded and found to be serious and day-long, it is safe to compare the bucket analyses to the below screening levels or standards in order to decide whether further study is required, and to trigger action based on the Precautionary Principle. The bucket samples are of air taken from near residential areas. Women and children living in the SIPCOT residential areas have been subject to air pollution 24-hours a day, all days of the year and for several years already.

**1. Screening or minimum risk level:**
These levels are generally based on studies of health effects of individual pollutants. Concentration levels of these pollutants are set either in relation to a specified level of risk or to the level at which it is thought that the health effects are unlikely. The figures thus represent maximum permissible exposures.

- EPA region 6 Screening Level is calculated for residential exposure. The levels are based on a 1 in a million cancer risk or a 'hazard quotient' of 1 for non-cancer effects.
  http://www.epa.gov/earth1r6/6pd/rcra_c/pd-n/screen.htm

- Texas Effects screening Levels are set at the level below which health impacts are thought unlikely. Different levels are set for 'short-term' exposure – usually one hour – and 'long-term' exposure – usually one year, but only 24 hours for Benzene and Ethylene dichloride.
  http://www.tnrcc.state.tx.us/permitting/tox/esl.html

- ATSDR (Agency of Toxic Substance and Disease Registry) Minimal Risk Levels also sets levels according to duration of exposure: 'Acute indicates period of up to two weeks, 'intermediate' from two weeks and one year, and 'chronic' as longer than a year.
  http://www.atsdr.cdc.gov/mrls.html

**2. Standards**
Standards are legally enforceable. Two standards were used for comparison in this study:

- Louisiana Ambient Air Quality Standards differentiate between 8 hour exposure and 24 hour exposure.
  http://www.deq.state.la.us/planning/reg/title33/33v03.pdf

- North Carolina Ambient Air Standards sets annual standards, 24 hour standards and one hour standards for systemic toxicants and irritants.
  http://daq.state.nc.us/Rules/rules/D1101-06.pdf

For the purposes of simplicity, this study report highlights the bucket analyses as compared with EPA Region 6 Screening Levels as these figures represent levels of concern for residential areas. Comparison with other levels and standards are tabulated in **Annexure 1.**

## Findings and discussion:

Starting March 2004, the SACEM began recording chemical odour incidents. Between March and June 2004, the SACEM sampled five of the numerous chemical odour incidents that they determined to be of an “intense” or”serious” nature.

**Odour = Chemical Pollution**
An August 2004 indicative study on chemical odour incidents by SACEM documents 223 intense incidents during a 14-week study period. The study found that odours were prevalent throughout the day, with the frequency of intense incidents increasing towards evening and night.

For instance, in June 2004, monitors sampled air downwind of Shasun Chemicals that had an “Acid smell, rotten sweet fruit-like smell.” As part of the August 2004 study, monitors had recorded at least 63 instances of similar odour at various locations in the industrial estate and at various times of the day.

**Table 2: Odours tested for, probable sources and frequency of incidents as recorded in the August 2004 study.**

| Odour tested for | Probable source of the odour | Number of times odour reported |
|---|---|---|
| Rotten dead dog/animal smell | Shasun Chemicals | 6 |
| Acid smell, rotten sweet fruit like smell | Shasun Chemicals | 63 |
| Chikoo smell | Asian Paints | 24 |
| Sweet smell, hospital smell, spirit smell | Tagros Chemicals | 14 |
| Gutter smell and rotten egg smell | CUSECS No 5 | 64 |

**Above Levels of Concern**
Out of 22 chemicals at least 16 violate one or more Levels of Concern set by various agencies in the United States. While the levels of all 16 chemicals are above the prescribed limits, some of these chemicals are as much as 20,000 times over the limits. A list of all the chemicals found and their health effects is in **Annexure 2** below. A few of chemicals that were found at very high levels are listed in Table 3 below.

**Vulnerable Populations**
The findings of this report are of particular concern to vulnerable populations, such as workers, pregnant women, the elderly and children. The EPA Region 6 levels of concern that are used for comparison are calculated for adult North American males weighing 70 kg. As the weight and age of the subject goes down, the maximum permissible exposure levels would also need to be reduced.

The very presence of the chemicals found in this study in residential air is cause for concern, especially given that women, children and the elderly who tend to spend all their time in and around home may be exposed to dangerous levels of these chemicals over a period of time.

As described below, the chemicals detected were found at extremely high levels in the air outside the factory fenceline. Naturally, the levels closer to the source of the chemicals within the factory are likely to be far higher. That is cause for serious concern for workers who may be exposed to these chemicals at the workplace.

**Probable Pollution Sources**

At least 13 chemicals detected in the air are known to be used in the industries in SIPCOT. Chemicals, particularly those used as raw materials, are known to escape into the environment as fugitive emissions. The levels of fugitive emissions vary depending on how well the factory is run. The levels of chemicals found in SIPCOT, indicate that fugitive emissions from the factories are significant enough to trigger corrective action.

Such high levels of chemicals in ambient air near factories are also indicative of poor housekeeping within the industries. Poor housekeeping also generally heightens the risk of reactive accidents like the disaster that happened in Bhopal in 1984.

**Table 3: Comparison of levels of chemicals found to EPA Region 6 Screening Levels**

| **Name of the Chemical found and their reported value** | **Number of times it exceeds EPA region 6 Limits* and other remarks. (All locations are downwind of noted industrial sources. The chemicals found are likely to have but may not have originated from the industrial sources upwind of sample locations.)** |
|---|---|
| **Methylene Chloride**<br>3700 micrograms/m3 – CUSECS Sample<br>300 micrograms/m3 – Shasun Sample 1<br>360 micrograms/m3 – Shasun Sample 2 | ▪ **905** times above the limit in sample taken downwind of Cusecs Number 5<br>▪ **73** times above the limit in 1st sample taken downwind of Shasun<br>▪ **88** times above the limit in 2nd sample taken downwind of Shasun |
| **Trichloroethene (aka Trichloroethylene)**<br>780 micrograms/m3 – CUSECS Sample<br>140 micrograms/m3 – Asian Paints Sample<br>96 micrograms/m3 – Shasun Sample 2 | ▪ **709** times above the limit in sample taken downwind of Cusecs Number 5<br>▪ **127** times above levels in sample taken downwind of Asian Paints<br>**87** times above the limit in 2nd sample taken downwind of Shasun |
| **Chloroform**<br>350 micrograms/m3 – Shasun Sample 1<br>430 micrograms/m3 – Shasun Sample 2<br>80 micrograms/m3 – Tagros Sample | ▪ **4166** times above the limit in 1st sample taken downwind of Shasun<br>▪ **5119** times above the limit in 2nd sample taken downwind of Shasun<br>▪ **952** times above the limit in sample taken downwind of Tagros |
| **Carbon Tetrachloride**<br>15 micrograms/m3 – Shasun Sample 1<br>1500 micrograms/m3 – Tagros Sample | ▪ **115** times above the limit in 1st sample taken downwind of Shasun<br>▪ **11538** times above the limit in sample taken downwind of Tagros |
| **Hydrogen Sulphide**<br>874 micrograms/m3 – CUSECS Sample<br>7.36 micrograms/m3 – Shasun Sample 2<br>13.1 micrograms/m3 – Tagros Sample | ▪ **874** times above the limit in sample taken downwind of Cusecs Number 5<br>▪ **7.36** times above the limit in 2nd sample taken downwind of Shasun<br>▪ **13.1** times above the limit in sample taken downwind of Tagros |
| **Benzene**<br>21 micrograms/m3 – Tagros Sample | ▪ **108** times above the limit in sample taken downwind of Tagros |
| **Vinyl Chloride**<br>55 micrograms/m3 – Tagros Sample | ▪ **250** times above the limit in sample taken downwind of Tagros |
| **1,2-Dichloroethane**<br>1700 micrograms/m3 – Tagros Sample | ▪ **22973** times above the limit in sample taken downwind of Tagros |
| **Acrolein**<br>6.5 micrograms/m3 – Asian Paints Sample | ▪ **320** times above the limit in sample taken downwind of Asian Paints |

# Annexure 1

**List of chemicals found in the samples, their locations and levels detected**

**Sample 1: CUSECS 5.**
**Date of Sampling: 04 March, 2004.**
**Location: SIPCOT Road No. 5, opp. Loyal Super Fabrics**

| **Chemical found** | **$\mu g/m^3$** | **ppbV** | **EPA Level $\mu g/m^3$** |
|---|---|---|---|
| Hydrogen Sulphide | 874* | 627 | 1.00 |
| Methyl Mercaptan | 13.3* | 6.74 | 2.1 |
| Dimethyl Sulphide | 9.04 | 3.56 | |
| Ethanol | 44 | 24 | |
| Methylene Chloride | 3700* | 1100 | 4.09 |
| Trichloroethene | 780* | 150 | 1.10 |
| Toluene | 42 | 11 | 400 |

* Exceeds EPA Effects Screening Levels

**Sample 2: Downwind of Shasun Chemicals.**
**Date of Sampling: 05 March, 2004.**
**Location: In front of TASMAC office**

| **Chemical Found** | **$\mu g/m^3$** | **ppbV** | **EPA Level $\mu g/m^3$** |
|---|---|---|---|
| Methyl Mercaptan | 26.8* | 13.7 | 2.1 |
| Dimethyl Sulphide | 282 | 111 | |
| Dimethyl Disulphide | 53.5 | 13.9 | |
| Ethanol | 130 | 70 | |
| Acetone | 220 | 94 | 370 |
| Isopropyl Alcohol | 680 | 280 | |
| Methylene Chloride | 300* | 86 | 4.09 |
| n-Hexane | 44 | 13 | 210 |
| Chloroform | 350* | 72 | 0.084 |
| Carbon Tetrachloride | 15* | 2.4 | 0.13 |
| Toluene | 210 | 56 | 400 |

***** Exceeds EPA Effects Screening Levels

**Sample 3: Downwind of Shasun Chemicals.**
**Date of Sampling: 03 June, 2004.**
**Location: In front of Shasun Main Gate**

| **Chemical Found** | **$\mu g/m^3$** | **ppbV** | **EPA Level $\mu g/m^3$** |
|---|---|---|---|
| Hydrogen Sulphide | 7.36* | 5.28 | 1.00 |
| Acetone | 210 | 87 | 370 |
| Isopropyl Alcohol | 610 | 250 | |
| Methylene Chloride | 360* | 100 | 4.09 |
| n-Hexane | 160 | 45 | 210 |
| Chloroform | 430* | 87 | 0.0840 |
| Trichloroethene | 96* | 18 | 1.10 |
| Toluene | 820* | 220 | 400 |
| n-Butyl Acetate | 34 | 7.2 | |

* Exceeds EPA Effects Screening Levels

**Sample 4: Downwind of Tagros Chemicals.**
**Date of Sampling: 21 June, 2004.**
**Location: Service road along North wall of Tagros factory**

| **Chemical Found** | **$\mu g/m^3$** | **ppbV** | **EPA Level $\mu g/m^3$** |
|---|---|---|---|
| Hydrogen Sulphide | 13.1 | 9.38 | |
| Methyl Mercaptan | 11.6 | 5.9 | |
| Carbon Disulphide | 11.0 | 3.52 | |
| Dimethyl Disulphide | 11.7 | 3.03 | |
| Vinyl Chloride | 55 | 22 | |
| Bromomethane | 47 | 12 | |
| Acetonitrile | 550 | 330 | |
| Isopropyl Alcohol | 110 | 44 | |
| n-Hexane | 4200* | 1200 | 210 |
| Chloroform | 80 | 16 | |
| 1,2-Dichloroethane | 1700* | 410 | 0.0740 |
| Benzene | 27* | 8.6 | 0.25 |
| Carbon Tetrachloride | 1500* | 240 | 0.13 |
| Toluene | 700* | 190 | 400 |

* Exceeds EPA Effects Screening Levels

**Sample 5: Downwind of Asian Paints**
**Date of Sampling: 21 June, 2004**
**Location: Service road next to Asian Paints**

| **Chemical Found** | **$\mu g/m^3$** | **PpbV** | **EPA Level $\mu g/m^3$** |
|---|---|---|---|
| Hydrogen Sulphide | 8.69* | 6.24 | 1.00 |
| Acrolein | 6.5* | 2.8 | 0.021 |
| Vinyl Acetate | 9.0 | 2.5 | 210 |
| Trichloroethene | 140* | 26 | 1.10 |
| Toluene | 17 | 4.4 | 400 |
| n-Butyl Acetate | 7.9 | 1.7 | |

* Exceeds EPA Effects Screening Levels

# Annexure 2

## Health Effects of Chemicals Found in SIPCOT Air

| SNo | Chemical found (Name of units that use chemical as raw material) | Odour | Found in samples taken downwind of | Health Effects | Target Organs | Carcinogen |
|---|---|---|---|---|---|---|
| 1. | Hydrogen Sulphide | Rotten eggs | ▪ CUSECS 5<br>▪ Shasun Chemicals.<br>▪ Tagros<br>▪ Asian paints | Irritation of eyes, respiratory system; coma, convulsion, conjunctivitis, eye pain, tears to eyes, dizziness, headache, weakness and exhaustion, insomnia, gastrointestinal disturbance | Eyes, respiratory system, Central Nervous System | ✕ |
| 2. | Methyl Mercaptan (Shasun) | disagreeable odour like garlic or rotten cabbage | ▪ CUSECS 5<br>▪ Shasun Chemicals<br>▪ Tagros | Irritation eyes, skin, respiratory system; narcosis, convulsion | Eyes, skin, respiratory system, Central Nervous System, blood | ✕ |
| 3. | Dimethyl Sulphide (Shasun, SPIC) | NA | ▪ CUSECS 5 | Irritation eyes, skin, respiratory system | Eyes, skin, respiratory system, Central Nervous System, blood | ✕ |
| 4. | Ethanol (Morgan Acid) | Characteristic suffocating odour | ▪ CUSECS 5<br>▪ Sample 1 Shasun | Irritation eyes, skin, nose; headache, drowsiness, lassitude (weakness, exhaustion), narcosis; cough; liver damage; anemia; reproductive, teratogenic effects | Eyes, skin, respiratory system, central nervous system, liver, blood, reproductive system | ✕ |
| 5. | Methylene Chloride (Shasun, SPIC) | Faint sweet odour | ▪ CUSECS 5<br>▪ Sample 2 Shasun<br>▪ Sample 1 Shasun | Irritation eyes, skin; lassitude (weakness, exhaustion), drowsiness, dizziness; numbness, tingle limbs; nausea; [potential | Eyes, respiratory system<br>**Cancer Site:** [in animals: lung, liver, salivary & | ✔ |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | occupational carcinogen] | mammary gland tumors] | |
| 6. | Trichloroethene | Chloroform like odour | ▪ CUSECS 5<br>▪ Sample 2 Shasun<br>▪ Asian Paints | Irritation of eyes and skin; headache, visual disturbances, weakness and exhaustion, dizziness, tremor, drowsiness, nausea, vomiting, dermatitis liver injury, carcinogen | Eyes, skin, respiratory system, heart, liver, kidneys **Cancer Site:** [in animals: liver and kidney cancer] | ✔ |
| 7. | Toluene (SPIC, Morgan Industries, Morgan Acids, Tantech Agro) | Sweet pungent benzene like odour | ▪ CUSECS 5<br>▪ Sample 1 Shasun<br>▪ Tagros<br>▪ Sample 2 Shasun<br>▪ Asian paints | Irritation of eyes, nose, weakness and exhaustion, confusion, euphoria, dizziness, headache, dilated pupils and tears to eyes, anxiety, muscle fatigue, insomnia, dermatitis, liver injury, kidney damage | Eyes, skin, respiratory system, Central nervous system, liver and kidney | ✕ |
| 8. | Dimethyl Disulphide | NA | ▪ Sample 1 Shasun<br>▪ Tagros | Irritation eyes, skin, respiratory system | Eyes, skin, respiratory system, Central Nervous System, blood | NA |
| 9. | Acetone (Morgan Acids) | Fragrant mint like odour | ▪ Sample 2 Shasun Chemicals.<br>▪ Sample 1 Shasun | Irritation eyes, nose, throat; headache, dizziness, central nervous system depression; dermatitis | Eyes, skin, respiratory system, central nervous system | ✕ |
| 10. | Isopropyl Alcohol | Odour of rubbing alcohol | ▪ Sample 2 Shasun<br>▪ Sample 1 Shasun<br>▪ Tagros | Irritation eyes, nose, throat; drowsiness, dizziness, headache; dry cracking skin; in animals: narcosis | Eyes, skin, respiratory system | ✕ |
| 11. | *n*-Hexane (Shasun, Tagros) | Gasoline like odour | ▪ Sample 2 Shasun<br>▪ Sample 1 Shasun | Irritation of eyes, nose, nausea, headache, peripheral neuropathy, numbness, extremities, | Eyes, skin, respiratory system, Central Nervous System | ✕ |

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| | | | | muscle weakness, dermatitis, dizziness, chemical pneumonia | | |
| 12. | Chloroform | Pleasant odour | ▪ Sample 1 Shasun<br>▪ Sample 2 Shasun<br>▪ Tagros | Irritation of eyes, skin; dizziness, mental dullness, nausea, confusion; headache, weakness, exhaustion; anesthesia, enlarged liver [potential carcinogen] | Liver, kidneys, heart, eyes, skin, Central nervous system<br>**Cancer Site:** [in animals: liver and kidney cancer] | ✔ |
| 13. | Carbon Tetrachloride (Shasun, Tagros) | Characteristic ether like odour | ▪ Sample 1 Shasun<br>▪ Tagros | Irritation of eyes, skin, CNS depression, nausea, vomiting, liver, kidney injury, drowsiness, dizziness | Eyes, respiratory system, lungs, liver, kinder, skin<br>**Cancer Site:** [in animals: liver cancer] | ✔ |
| 14. | *n*-Butyl Acetate | Fruity odour | ▪ Sample 1 Shasun<br>▪ Asian paints | Irritation eyes, skin, upper respiratory system; headache, drowsiness, narcosis | Eyes, skin, respiratory system, central nervous system | ✕ |
| 15. | Vinyl Chloride | Pleasant odour | ▪ Tagros | Weakness, exhaustion; abdominal pain, gastrointestinal bleeding; enlarged liver; pallor or cyanosis of extremities; liquid: frostbite; [potential occupational carcinogen] | Liver, central nervous system, blood, respiratory system, lymphatic system<br>**Cancer Site:** liver | ✔ |
| 16. | Bromomethane | Chloroform like odour | ▪ Tagros | Irritation eyes, skin, respiratory system; muscle weakness, in-coordination, visual disturbance, dizziness; nausea, vomiting, headache; malaise (vague feeling of | Eyes, skin, respiratory system, central nervous system<br>**Cancer Site** [in animals: lung, | ✔ |

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| | | | | discomfort); hand tremor; convulsions; dyspnea (breathing difficulty);[potential occupational carcinogen] | kidney & fore-stomach tumors] | |
| 17. | Acetonitrile (Tagros) | Aromatic odour | ▪ Tagros | Irritation nose, throat; asphyxia; nausea, vomiting; chest pain; lassitude (weakness, exhaustion); stupor, convulsions; in animals: liver, kidney damage | Respiratory system, cardiovascular system, central nervous system, liver, kidneys | ✕ |
| 18. | 1,2-Dichloroethane (Tantech Agro) | Chloroform like odour | ▪ Tagros | Irritation eyes, corneal opacity; central nervous system depression; nausea, vomiting; dermatitis; liver, kidney, cardiovascular system damage; [potential occupational carcinogen] | Eyes, skin, kidneys, liver, central nervous system, cardiovascular system **Cancer Site** [in animals: fore-stomach, mammary gland & circulatory system cancer] | ✔ |
| 19. | Benzene (Shasun, Morgan Acids) | Aromatic odour | ▪ Tagros | Irritation eyes, skin, nose, respiratory system; dizziness; headache, nausea, staggered gait; anorexia, lassitude (weakness, exhaustion); dermatitis; bone marrow depression; [potential occupational carcinogen] | Eyes, skin, respiratory system, blood, central nervous system, bone marrow **Cancer Site:** Bone marrow (leukemia) | ✔ |
| 20. | Acrolein | Piercing disagreeable odour | ▪ Asian paints | Irritation eyes, skin, mucous membrane; decreased pulmonary function; delayed | Eyes, skin, respiratory system, heart | ✕ |

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| | | | | pulmonary edema; chronic respiratory disease | | |
| 21. | Vinyl Acetate (Morgan Acids) | Pleasant fruity odour | ▪ Asian paints | Irritation eyes, skin, nose, throat; hoarseness, cough; loss of smell; eye burns, skin blisters | Eyes, skin, respiratory system | ✕ |
| 22. | Carbon Disulphide (SPIC) | Sweet ether like odour | ▪ Tagros | Headache, dizziness, restlessness, increased heart rate, Blood pressure, coma, convulsion | Respiratory system and cardio vascular system | ✕ |

# Annexure 3

**From: Dr. Mark Chernaik and Meche Lu**
**Staff Scientists, E- LAW U. S.**
**Oregon, USA**
**August 18th 2004**

**Interpretation of the results of Air samples from Cuddalore**

What follows is the interpretation of the results of the laboratory analysis of the following ambient air samples form SIPCOT, Cuddalore. Air samples were taken from four locations:

1. Near Shasun Chemicals, on 5 March 2004 and 3 June 2004.

2. Near CUSECS-5 SIPCOT Road, on 4 March 2004.

3. Near TAGROS Chemicals, on 21 June 2004)

4. Near Asian Paints, on 21 June 2004

Air samples were sent to a laboratory for analysis of levels of various sulfide compounds and volatile organic compounds (VOCs). What follows is our interpretation of air pollutant levels that might pose substantial health risks to persons in the vicinity of these four locations.

**1. Near Shasun Chemicals**

**Chloroform** levels near Shasun Chemicals were above health-based guidelines. The chloroform level in the air sample taken on 5 March 2004 was 350 ug/m3 (0.35 mg/m3). The chloroform level in the air sample taken on 3 June 2004 was 0.39 mg/3 (average of a duplicate analysis).

According to the U.S. EPA: "Chronic exposure to chloroform by inhalation in humans is associated with effects on the liver, including hepatitis and jaundice, and central nervous system effects, such as depression and irritability. ... EPA considers chloroform to be a probable human carcinogen and has ranked it in EPA's Group B2. The California Environmental Protection Agency (Cal EPA) has established a chronic reference exposure level of 0.3 milligrams per cubic meter (mg/m3) for chloroform based on exposures resulting in kidney and liver effects in rats. ... ATSDR has established ... a chronic inhalation MRL of 0.1 mg/m3 ... also based on liver effects in humans." http://www.epa.gov/ttn/atw/hlthef/chlorofo.html

Therefore, chloroform levels near Shasun Chemicals were 1.17 and 1.3 times the Cal EPA chronic reference exposure level for chloroform and 3.5 and 3.9 times the ATSDR chronic inhalation MRL for chloroform.

**Toluene** levels near Shasun Chemicals were also above health-based guidelines. The toluene level in the air sample taken on 3 June 2004 was 0.785 mg/3 (average of a duplicate analysis).

According to the U.S. EPA: "Chronic inhalation exposure of humans to toluene causes irritation of the upper respiratory tract and eyes, sore throat, dizziness, headache, and difficulty with sleep." http://www.epa.gov/ttn/atw/hlthef/toluene.html.
The WHO guideline value for toluene is 0.26 mg/m3 (one week averaging time). http://star.eea.eu.int/showResult.asp?selection=5496&themeID=11&class=inst&instr=Gudelines
The U.S. EPA Reference Concentration (RfC) for toluene "is 0.4 mg/m3 based on neurological effects in humans and degeneration of the nasal epithelium in rats." http://www.epa.gov/ttn/atw/hlthef/toluene.html

Therefore, toluene levels near Shasun Chemicals were approximately 3.0 times the WHO guideline value for toluene, and approximately 2.0 times the U.S. EPA RfC for toluene.
[Note, however, that the toluene level in the air sample taken on 5 March 2004 was 0.210 mg/3, which is below the WHO guideline value for toluene and the U.S. EPA RfC for toluene].

## 2. Near CUSECS-5 SIPCOT Road No. 5 Opposite Loyal

**Hydrogen sulfide** levels near CUSECS-5 SIPCOT Road were above health is above health-based guidelines. The hydrogen sulfide level in the air sample taken on 4 March 2004 was 0.890 mg/m3 (average of a duplicate analysis).

The WHO guideline values for hydrogen sulfide are 0.007 mg/m3 (30 minute averaging time) and 0.150 mg/m3 (one week averaging time).
http://star.eea.eu.int/showResult.asp?selection=5487&themeID=11&class=inst&instr=Guidelines
The U.S. EPA Reference Concentration (RfC) for hydrogen sulfide is 0.002 mg/m3.
http://www.epa.gov/iris/subst/0061.htm

Therefore, hydrogen sulfide levels near CUSECS-5 SIPCOT Road were 127 times above the 30-minute WHO guideline value for hydrogen sulfide and 445 times above the U.S. EPA RfC for hydrogen sulfide.

**Methylene chloride** levels near CUSECS-5 SIPCOT Road were also above health health-based guidelines. The Methylene chloride level in the air sample taken on 4 March 2004 was 3.7 mg/m3.

According to the U.S. EPA: "The major effects from chronic inhalation exposure to Methylene chloride in humans are effects on the CNS, such as headaches, dizziness, nausea, and memory loss."
http://www.epa.gov/ttn/atw/hlthef/methylen.html.
The WHO guideline value for Methylene chloride is 3 mg/m3.
http://star.eea.eu.int/showResult.asp?selection=5483&themeID=11&class=inst&instr=Guidelines
The U.S. EPA "has calculated a provisional Reference Concentration (RfC) of 3 mg/m3 based on liver effects in rats." http://www.epa.gov/ttn/atw/hlthef/methylen.html

Therefore, Methylene chloride levels near CUSECS-5 SIPCOT Road were roughly 1.2 times above the WHO guideline values for Methylene chloride and the U.S. EPA provisional RfC for Methylene chloride.

**Trichloroethene** levels near CUSECS-5 SIPCOT Road were also above health-based guidelines. The Trichloroethene level in the air sample taken on 4 March 2004 was 0.78 mg/m3.

According to the U.S. EPA: "As with acute exposure, chronic exposure to trichloroethylene by inhalation also affects the human central nervous system. Case reports of intermediate and chronic occupational exposures included effects such as dizziness, headache, sleepiness, nausea, confusion, blurred vision, facial numbness, and weakness. ... The California Environmental Protection Agency (Cal EPA) has calculated a chronic inhalation reference exposure level of 0.6 mg/m3 based on neurological effects in humans. ... ATSDR has calculated an intermediate-duration inhalation minimal risk level (MRL) of ... 0.5 mg/m3 for trichloroethylene based on neurological effects in rats."
http://www.epa.gov/ttn/atw/hlthef/tri-ethy.html

Therefore, Trichloroethene levels near CUSECS-5 SIPCOT Road were 1.3 times above the Cal EPA chronic inhalation reference exposure level for Trichloroethene and roughly 1.6 times above the ATSDR MRL for Trichloroethene.

## 3. Near TAGROS Chemicals

**Acetonitrile** levels near TAGROS Chemicals were above health-based guidelines. The Acetonitrile level in the air sample taken on 21 June 2004 was 0.55 mg/m3.

According to the U.S. EPA: "Chronic inhalation exposure of humans to Acetonitrile results in cyanide poisoning from metabolic release of cyanide after absorption. The major effects consist of those on the central nervous system (CNS), such as headaches, numbness, and tremor. ... The Reference Concentration (RfC) for Acetonitrile is 0.06 milligrams per cubic meter (mg/m3) based on mortality in mice."
http://www.epa.gov/ttn/atw/hlthef/acetonit.html

Therefore, Acetonitrile levels near TAGROS Chemicals were roughly 9.2 times above the U.S. EPA RfC for Acetonitrile.

**Hexane** levels near TAGROS Chemicals were above health-based guidelines. The hexane level in the air sample taken on 21 June 2004 was 4.2 mg/m3.

According to the U.S. EPA "Chronic inhalation exposure to hexane is associated with sensorimotor polyneuropathy in humans, with numbness in the extremities, muscular weakness, blurred vision, headache, and fatigue observed. ... The Reference Concentration (RfC) for hexane is 0.2 milligrams per cubic meter (mg/m3) based on neurotoxicity in humans and epithelial lesions in the nasal cavity in mice." http://www.epa.gov/ttn/atw/hlthef/hexane.html.

Therefore, hexane levels near TAGROS Chemicals were 21 times above the U.S. EPA RfC for hexane.

**Ethylene dichloride** (1,2 Dichloroethane) levels near TAGROS Chemicals were above health-based guidelines. The ethylene dichloride level in the air sample taken on 21 June 2004 was 1.7 mg/m3. The California Environmental Protection Agency (Cal EPA) has calculated a chronic inhalation reference exposure level for ethylene dichloride of 0.4 mg/m3 based on hepatotoxicity and elevated liver enzyme levels in serum of rats. http://www.oehha.ca.gov/air/chronic_rels/pdf/107062.pdf

Therefore, the ethylene dichloride levels near TAGROS Chemicals were roughly 4.3 times the Cal EPA inhalation reference exposure level for ethylene dichloride.

**Carbon tetrachloride** levels near TAGROS Chemicals were also above health-based guidelines. The carbon tetrachloride level in the air sample taken on 21 June 2004 was 1.5 mg/m3. According to the U.S. EPA: "Chronic inhalation or oral exposure to carbon tetrachloride produces liver and kidney damage in humans and animals. ... EPA has classified carbon tetrachloride as a Group B2, probable human carcinogen." http://www.epa.gov/ttn/atw/hlthef/carbonte.html.
The WHO guideline value for carbon tetrachloride is 0.0061 mg/m3 (one year averaging time).
http://star.eea.eu.int/showResult.asp?selection=5481&themeID=11&class=inst&instr=Guidelines

"The California Environmental Protection Agency (Cal EPA) has established a chronic reference exposure level of 0.04 milligrams per cubic meter (mg/m3) for carbon tetrachloride based on liver effects in guinea pigs." http://www.epa.gov/ttn/atw/hlthef/carbonte.html

Therefore, carbon tetrachloride levels near TAGROS Chemicals were roughly 250 times the WHO guideline value for carbon tetrachloride and 40 times the Cal EPA chronic reference exposure level for carbon tetrachloride.

**Toluene** levels near TAGROS Chemicals were also above health-based guidelines. The toluene level in the air sample taken on 21 June 2004 was 0.70 mg/m3.As noted above, the WHO guideline value for toluene is 0.26 mg/m3 (one week averaging time) and the U.S. EPA Reference Concentration (RfC) for toluene is 0.4 mg/m3.

Therefore, toluene levels near TAGROS Chemicals were roughly 2.7 times the WHO guideline value for toluene, and roughly 1.8 times the U.S. EPA RfC for toluene.

### 4. Near Asian Paints

None of the levels of air pollutants detected in the air sample collected near Asian Paints on 21 June 2004 are above the California Environmental Protection Agency health-based guidelines.

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[1] "Odour policies, regulations in Australia and abroad." Centre for Water and Waste Technology, School of Civil and Environmental Engg, University of New South Wales, Sydney, Australia. http://www.odour.unsw.edu.au/odour-policy-regulation.html

[2] www.tidco.com/tn_policies/industrial_parks/cuddalore_industrial_park.asp

[3] Tamilnadu Pollution Control Board, 1999 data.

[4] Quoted from "The Indian People's Tribunal Report On Human Rights Violations, Industrial Pollution and the Implications of the Proposed Chemplast Sanmar PVC Factory in SIPCOT, Cuddalore, TN." IPT on Environment & Human Rights, July 2003

[5] "Chemical Odour Incidents in SIPCOT Industrial Area, Cuddalore." G.K. Amrithalingam, T. Arulselvam, G. Gowri, J. Parasuraman, G. Parthiban, S. Pugazhenthi, S. Ramanathan, Shweta Narayan, P. Sivakumar, S. Sivashankar. Community Environmental Monitoring, August 2004