

Critique of the *Chemplast Sanmar Limited* Health Study

Conducted by Government Mohan Kumaramangalam Medical College and Hospital



COMMUNITY ENVIRONMENTAL MONITORING

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Front cover, clockwise from top left:

Chemplast's pollution has sparked strong backlash and protest among villagers.

Construction of Chemplast's thermal power plant stalled because of the lack of necessary consents.

A farmer showing the former height of his crop, now stunted by land and water contamination.

A farmer suffers from permanent skin damage as a result of his contact with contaminated water in his field.

Section 1: Introduction

Since 2007, the Tamilnadu Pollution Control Board (TNPCB) has directed Chemplast Sanmar to conduct a health study in response to growing criticism of the environmental and health impacts of the company's operations in Mettur Dam. In early 2008, Chemplast commissioned a health study to avoid penal action by the TNPCB. This study was carried out by Government Mohan Kumaramangalam Medical College and Hospital. Its stated objective was to analyse the impact of Chemplast's chemical manufacturing operations on the health of its employees and the community. The study was completed in December 2008 and submitted to the TNPCB and the Loss of Ecology Authority, where there is a pending case for compensation for health damage and contamination of agricultural lands and groundwater by local farmers.

The authors of the study did not subject the study to a process of peer-review prior to publication. Since the findings of the study contradict public complaints and available facts about the extent of the contamination, Community Environmental Monitoring and the Gonur West Agriculturists Development Union circulated the study among experts in epidemiology, toxicology and environmental health for their critical comments. Out of the seven peer-reviewers, listed below, five had no prior knowledge about Chemplast Sanmar, its operations or the related allegations of environmental pollution. Dr. Mark Chernaik and Dr. Rakhil Gaitonde are familiar with the company's operations, and have assisted with earlier critiques of environmental pollution and health data.

The peer review experts included:

- a) Dr. Arthur L. Frank, Chair, Department of Environmental and Occupational Health, School of Public Health, Drexel University, Philadelphia, USA.

“Any objective review of a health situation should not include such effusive, apparently biased, praise for the group being evaluated.”

Dr. Arthur L. Frank

- b) Dr. Annie Thebaud-Mony, Director of Research, National Institute for Health and Medical Research, University of Paris, France.
- c) Dr. Rakhil Gaitonde, Public Health specialist, Community Health Cell, Bangalore.
- d) Dr. Mark Chernaik, Toxicologist and Staff Scientist, Environmental Law Alliance Worldwide (ELAW), Oregon, USA.
- e) Dr. V. Murlidhar, Occupational Health and Safety Centre, Mumbai.
- f) Dr. Arindam Basu, Senior Lecturer, Health Sciences Center, Health Sciences Assessment Collaboration, University of Canterbury, Christchurch, New Zealand Senior Lecturer
- g) Dr. Benedetto Terracini, Retired Professor of Biostatistics, University of Torino, Italy.

All seven experts agree that the health survey offers no useful insights into the health of the workers and community because of poor methodology and biased sampling. According to Dr. Arthur L. Frank, an authority in epidemiological methods, “Simply put, [the study] fails as a supposed ‘scientific’ study and were it to be submitted for publication in any scientific journal on which I serve on the editorial board, or as an article reviewer, it would be rejected as not meeting basic scientific standards.” Another expert, Dr. Arindam Basu refers to “serious methodological flaws and biases” that confound the results.

What follows is a detailed critique of the study, and a case for re-doing the study with methodological rigour.



From left to right:

Effluent pipelines from Plant 3 discharging effluents into the surplus course of River Kaveri.

Samivelu, pictured with his medications, was exposed to a chlorine gas leak from Chemplast Plant 3 when he was 20 day old.

Mercury is a neurotoxin used by Chemplast that accumulates in

Section 2: Summary of the Study

The study's stated objective is to conduct an “in-depth” analysis of the impacts of the manufacturing operations of Chemplast Sanmar Limited, Mettur, on the health of the employees and the fenceline communities. The study focuses on data collected from four different sources. It analyses blood and urine sample data of workers, morbidity and mortality statistics from three public health centers, data collected by the Department of Health, Salem through household surveys and data collected through free medical camps organised by the company. It also uses monthly averages of ambient air quality monitoring data for three years from seven stations as a measurement of pollution from the company's operations.

The study concludes that there is no pollution, or associated health effects, caused as a result of the company's operations in Mettur.

Section 3: Made to Order Science

A number of expert reviewers have commented on the evident predisposition of the authors of the report to conclude that the company does not pollute and that their operations have no impact on the environment or human health.

Dr. Thebaud-Mony comments that, “The methodology and findings suggest a pre-conclusion by the authors that the pollution has no effect among Mettur residents.” Indeed, the foreword to the study written by Dr. J. Nirmalson, Deputy Director of Health Services, Government of Tamilnadu, states that: “This extensive health data analysis is one of the new ventures to establish that there is no occupational disease threat to the employees and the nearby community.” This statement is repeated three times in the report. The fact that this aim – to establish that there is no occupational disease threat — is biased in favor of the company from the beginning makes the study scientifically unacceptable.

The authors of the study state that “Chemplast Sanmar Limited is known for their commitment in occupational health monitoring and industrial hygiene practices. Continuous involvement in improvement of safety, health, and environment has brought many laurels to the organisation.”

They go on to commend the company for its corporate social responsibility. Statements praising the company on its practices are seen throughout the study. Exceeding their purview of analyzing the health effects of the chemical operation, the authors attempt to demonstrate that Chemplast Sanmar is a ‘responsible corporate citizen.’ Dr. Arthur L. Frank in his critique of this study notes that “any objective review of a health situation should not include such effusive, apparently biased, praise for the group being evaluated.”

Section 4: Lack of Hypothesis

Dr. Benedetto Terracini states that, “The quality of the studies mentioned in this report is hard to evaluate: their design, materials and methods are described in very vague terms. It seems that data were collected in the absence of any hypothesis regarding specific associations between environmental exposures and health outcomes, thus precluding any inferential process.” Other reviewers have also stated that the study lacks verifiability because the sources of data sets mentioned or alluded to in the study are not clear.

Section 5: Absence of Control Populations

Dr. Gaitonde notes that the present study is a cross-sectional design with no control area studied. The results are merely compared with the overall average statistics for the state (in some places), for the nation (in some places) and for the region (in some places). He states that such a design is definitely not adequate to fulfill the stated objectives.

Section 6: Problems With the Sample Population

The sample populations chosen for the various analyses compromise the integrity and validity of the study, according to the expert reviewers.

i. Employee study group is insufficient -
The report mentions that ‘employees with more than 15 years of service in the industrial units and above 45 years of age’ form the study group. Contract workers constitute about 50 percent of the workforce at the Chemplast plant, and are

often assigned to work in areas involving potential chemical exposure. This workforce is not considered; the study considers only permanent workers in its sampling pool. Finally, the report does not mention the number of workers in the sample study group. This lapse makes it impossible to comment on the reliability of the sample.

Dr. Frank points out a fundamental bias in the sampling. “. . .the population being studied was selected by the company which means that any ill worker could have been selected out.” About 15 percent of the workers, who are in the same category as those selected for the study group, were excluded from the study, the Government Hospital report admits. The study offers no explanation for excluding these workers.

ii. Data collection through Free Medical Camps is open to bias - The authors of the study have used data generated through free medical camps run by the company to extrapolate results for residents in the vicinity of the factory. “Data from health camps can never be extrapolated to the whole population. These are neither random samples nor representative. The lab tests done in the camp are also in merely about 500 of the 5000 (approximate numbers) who attended the camp. There are no details as to how these were chosen,” according to Dr. Gaitonde.

“. . .the population being studied was selected by the company, which means that any ill worker could have been selected out.”

Dr. Arthur L. Frank

According to Dr. Basu, “The choice of medical camp data to extrapolate for the larger community exposes the study to selection bias. People who were too ill to attend the medical camps and those who were already being seen by another competent medical doctor would not have come.” He also adds that, “Both groups of absentees from the medical camp [are] likely to be less healthy and more ill than those who attended the camps.”

iii. PHC Data: Poor choice - The authors’ analyses of mortality and morbidity data from three Primary Health Centers suffer from a number of shortcomings. According to Dr. Rakhal

Gaitonde, “the very act of analysing morbidity data from PHCs to infer the morbidity among the general community is a very inadequate method, for there is clear data that only between 40 to 60 percent of people approach the Government for out-patient services,”

“Data from health camps can never be extrapolated to the whole population.”

Dr. Rakhal Gaitonde

iv. Failure to consider the Healthy-Worker Effect - It is an accepted fact in occupational epidemiology that a sample comprising only of workers currently in the workforce would suffer from a selection bias. Established scientific literature acknowledges that “an individual must be relatively healthy in order to be employable in a workforce, and both morbidity and mortality rates within the workforce are usually lower than in the general population.” [See “A review of the healthy worker effect in occupational epidemiology.” C.Y. Li and E.C. Sung. Occupational Medicine. Vol. 49, No. 4, pp. 225-229. 1999.] Workers whose health has been harmed by prior chemical exposure would have very likely terminated their employment or exited the workforce through the Voluntary Retirement Scheme, or would have been lost among the retirees and pensioners. Usually such a bias is overcome by considering workers who withdrew from the workforce and pensioners as part of the sample.

The Government Hospital report mentions the Healthy Worker Effect as a limitation. Yet, the study design does nothing to address this limitation.

Section 7: Insufficient Consideration of Data

Dr. Basu points out that the study has not taken into consideration the impact of contamination by different toxic substances handled by the company and their specific effects on human beings.

i. Chemicals - Chemplast Sanmar uses as raw material or produces chemicals such as Chloroform, Poly Vinyl Chloride, Ethylene Dichloride, Vinyl Chloride Monomer, Chlorine, Methylene Chloride, Fumed Silica and

Chlorosilicones.¹ Many of these are toxic chemicals, and persistent in the environment. An analysis of sediment, sludge and water samples collected in and around Chemplast Sanmar's industries in Mettur by the TNPCB on 17 December 2007 revealed the presence of several chemicals at levels above the prescribed standards. Chloroform, Methylene Chloride, Chlorobenzene, Ethylene Dichloride, Bis-2 Ethylhexyl Phthalate, Vinyl Chloride were some of the chemicals found at high levels in the environment in Mettur.²

“The study also does not present data on the different sources of pollution.”

Dr. Annie Thebaud-Mony

The study neither identifies chemicals of concern, nor looks for health effects that may be caused by these chemicals. The study does not attempt to identify how much of the toxic compounds might have been released in the environment nor how much exposure individuals in the study might have had. Dr. Annie Thebaud-Mony states that the study also does not present data on the different sources of pollution, such as gas leaks, effluent discharges and hazardous waste dumps.

ii. Diseases - The study does not focus on the health problems commonly associated with chemicals used or manufactured by Chemplast Sanmar. For example, mercury is a toxic chemical that was used by Chemplast Sanmar Plant 3 in the manufacture of chlorine.

“Using [data] at the district level to extrapolate to the context of Mettur is totally inappropriate...”

Dr. Rakhal Gaitonde

Mercury is a known neurotoxin, but the study fails to investigate neurological problems in the sample population. Dr. Arthur L. Frank notes that the authors of the study failed to look for cases of angiosarcoma of the liver among the sample pool, even though the disease is associated with production of vinyl plastic, one of Chemplast's products. According to Dr. Basu, “Chemplast Sanmar was known to produce several chemical compounds that are

known to cause cancers. These details have not been highlighted.”

iii. Cancer - The study analyses Salem District's cancer records for three years and compares them with the cancer records of other districts of Tamilnadu in order to determine if cancer rates in the region were abnormal. Dr. Rakhal Gaitonde explains that “using the Cancer Registry data at the district level (for Salem) to extrapolate to the context of Mettur is totally inappropriate given the geographical scope of the Registry and the fact that it is not designed to reflect the cancer incidence for such small areas.” Dr. Benedetto Terracini notes; “The report states that ‘no occupational cancer has been identified or reported’ However, nowhere in the report is there a description of the means which have been implemented to identify cancers which could be attributed to the workplace. Conventional population-based cancer registries do not systematically collect occupational histories of cases.”

Moreover, the time period for which data has been analysed in this study is too short a period to help arrive at a legitimate conclusion. The health study only looked at cancer records for the past three years. The latency period between exposure to a carcinogen and the onset of cancer can be several decades. The health study would need to examine a prolonged period of cancer statistics to truly determine the absence of an association between cancer prevalence in Mettur and pollutant releases from the Chemplast Sanmar's PVC manufacturing facility.

“As a company making vinyl plastic, cases of angiosarcoma of the liver were not looked for.”

Dr. Arthur L. Frank

iv. Air Sampling is inadequate to determine pollution levels - The researchers analysed ambient air quality data from the TNPCB for three years between 2005 and 2007 to establish that there was no pollution by Chemplast Sanmar. This data is limited and insignificant, as only suspended particulate matter, Sulphur Dioxide, Nitrogen Oxide, Chlorine, and Carbon Monoxide were analysed in the regular monitoring process. Many of the

¹ Refer to Annexure 2 for a complete list of chemicals used/produced by Chemplast Sanmar in Mettur.

² Refer to Annexure 1 for details of the 17 December 2007 sampling analysis by the Tamilnadu Pollution Control Board

chemicals used by Chemplast Sanmar in Mettur are volatile organic compounds. In April 2006, Community Environmental Monitoring reported the presence of 17 toxic chemicals, of which eight were above the USEPA screening levels. Hydrogen Sulphide was found at 296 times higher than the screening levels, Vinyl Chloride at 2136 times higher, and 1,2-Dichloroethane was found at 32,432 times higher than the screening levels. These chemicals are toxic and hazardous to human health.

Further, Dr. Arindam Basu comments that, “Only considering ambient air quality data misses the other possible exposure variables that may have more direct impact: level of chemicals at the site where most employees were expected to be sited, stratified by their locations within the plant, level of chemicals and other known effluents in the soil, water, and air.”

The study would have to look for volatile organic chemicals, heavy metals and organochlorines in air, water and soil in the area around the factory in order to actually conclude an absence of contamination.

Section 8: Failure to Interpret Findings

The study concluded that the health of the employees of Chemplast Sanmar and the people living around the factory premises has not been affected by the operations of Chemplast Sanmar. Even the limited techniques of analysing data employed in this study are compromised if the findings are presented without any interpretation or explanation.

Dr. Benedetto Terracini states that, “I am surprised by the absolute number of deaths attributed to jaundice in the absence of cirrhosis: the aetiology of these deaths has not been investigated. Further, it seems that no effort has been made to assess the association between the occurrence of bronchitis and air pollution either in the workplace or in the general environment.”

Dr. Mark Chernaik notes that, “14.2% is remarkably high incidence among women participants to exhibit ‘thyroid disease’. Exposure to mercury is known to affect the

thyroid. According to the U.S. Agency for Toxic Substances and Disease Registry, ‘Several studies have reported effects on the thyroid after acute or intermediate-duration exposure to mercuric chloride.’ However, this possible association between exposure to mercury and prevalence of thyroid was not explored by the authors.

“The study is unscientific, and hence unreliable to assess whether and to what extent the community’s health has been affected by pollution from Chemplast Sanmar. The Study lacks integrity and should be disregarded.”

Dr. Annie Thebaud-Mony

Section 9: Conclusion

The numerous inconsistencies and errors in the methodology and design of the study pointed out by the expert doctors have been elaborated and discussed in this report. The findings of such a study are bound to be biased, inaccurate and unreliable.

Dr. Annie Thebaud-Mony concludes that, “the study is unscientific, and hence unreliable to assess whether and to what extent the community’s health has been affected by pollution from Chemplast Sanmar. The Study lacks integrity and should be disregarded.”

“Reviewing the data – it seems impossible to reach any clear conclusions given the incomplete and non-representative nature of the data. The available data based on which the conclusions are drawn are clearly inadequate to reach the sweeping nature of conclusions,” Dr. Gaitonde sums up.

Therefore, there is an urgent need for an independent, unbiased and scientifically sound study to be conducted. Community Environmental Monitoring and Gonur West Agriculturist's Development Union demand for such a study to be conducted by the Tamilnadu Pollution Control Board, with costs for this borne by Chemplast Sanmar Limited.

Annexure 1

Mettur is an agricultural and industrial town located on the banks of River Kaveri. One of the most prominent features in the town is the the Mettur Dam. The dam forms the Stanley Reservoir, which has a command area of 1,30,000 hectares and can generate up to 40 megawatts of electricity; it is also a major source of drinking water and irrigation. According to Professor Janakarajan of Madras Institute of Development Studies, the Kaveri irrigates 24 lakh acres of land across central and eastern Tamilnadu.

The following background is provided to highlight the evidence of pollution by Chemplast in Mettur. Given the rich base of data relating to chemicals released by the company, it is curious that no effort was made by the authors of the Government Hospital health study to look for health problems likely to have been caused by these pollutants. The below background also presents evidence to counter the authors' and Dr. J. Nirmalson's contention that the company is environmentally responsible.

Mettur – Ground Situation

Industrialisation in Mettur began in 1936 when Mettur Chemicals and Industries Corporation set up a caustic chlorine unit in Mettur, which was later purchased by Chemplast Sanmar. The first documented evidence of pollution dates back to 1965. Various official documents from that year, including reports from the Revenue Divisional Office, the Tamilnadu Pollution Control Board, the Salem Collectorate, local Panchayats, and the Tahsildar, document land and water contamination resulting from the operations of Chemplast Sanmar and other companies in the area. Chemplast has been forced to clean up water supplies and provide compensation in numerous cases since then.

In 2005, the Indian People's Tribunal, headed by Justice (Retd.) Akbar Basha Kadri, conducted an enquiry on Environmental and Human Rights violations by Chemplast Sanmar and MALCO industries in Mettur, Tamilnadu. The report describes "the appalling scenario prevalent in Mettur of indiscriminate disposal of hazardous wastes and the resultant devastation of environment and public health. Chemplast Sanmar's factories, including the PVC plant, were found to be responsible for polluting the water and soil of the area. The company has dumped toxic wastes – including mercury-bearing sludge and EDC/VCM tars from PVC production in pits. This has led to serious contamination of groundwater, and this contamination is spreading."

A November 2007 study released by Community Environmental Monitoring titled 'Unfolding Disaster - A Study of Chemplast Sanmar's Toxic Contamination in Mettur' reported that, "Chemplast's operations have and are contributing to the widespread contamination of Mettur's environment with mercury and a host of toxic chlorinated chemicals, including potentially dioxins." Of the 52 detected chemicals in the nine samples of soil, sediment and water taken in Mettur, 15 were found to be above safety levels prescribed by various international regulatory agencies.

Allegations against the company

Local villagers allege that the operations of Chemplast Sanmar have caused serious and irreversible water and land contamination thereby destroying the livelihoods of thousands of farmers living in the area. The salt and chemical content of the ground water is higher than permissible. The health of the workers and community has been severely compromised due to the presence of toxic chemicals, including carcinogens, in the air, water and soil of Mettur. Chemplast Sanmar has a track record of operating its units without license, ignoring safety procedures while handling toxic chemicals, disposing hazardous waste in unsafe unlined pits, discharging chemical effluence into the River Kaveri at levels above the prescribed limits, employing contract workers to do skilled jobs, causing workers to be exposed to chemicals, and producing beyond capacity, which has resulted in modest to massive gas leaks, worker accidents and other incidents of pollution. The following table lists accidents, gas leaks and other incidents of pollution from Chemplast Sanmar in Mettur since 2007.

S.No	Date	Details
1.	19.11.07	Gunasekaran, a contract worker from Salem Camp, was crushed to death in a construction accident at the site of Chemplast's coal-fired thermal power plant.
2.	27.11.07	An explosion at Chemplast power plant site sent huge boulders flying into the nearby residential area, causing damage to some of the houses, and panic among the residents.
3.	07.12.07	There was a major leak of chlorine gas (4.9 ppm) from Chemplast Sanmar's chloralkali plant. Some people rushed to nearby private doctors and hospitals for treatment. Residents complained of a burning sensation in the eye, bloated stomach, giddiness & vomiting.
4.	10.12.07	At 1.35 p.m., a fire began in the monomer cooling tower in the PVC division of Chemplast Sanmar. The fire lasted 15 minutes.
5.	28.01.08	A contract worker, Prithviraj, age 25 yrs, died after being injured in an accident at the Chemplast thermal plant construction site.
6.	03.02.08	A massive fish kill of tilapia and an eel-like freshwater fish occurred 100 meters down stream of Chemplast's effluent discharge point in the River Kaveri. Fish kills in this location are routine, with similar kills reported in November 2004, and July 2006.
7.	10.02.08	An underground effluent pipeline suspected to be from Chemplast carrying effluents to River Kaveri was accidentally broken, causing effluents to leak into residential areas. Similarly, about two months prior, a pipeline was accidentally broken in a house. The pipe contained a dark-colored liquid with strong chemical odour. Chemplast sent workers to fix the pipeline.
8.	06.03.08	Another underground pipeline carrying effluents was accidentally broken at the Railway Station in Mettur. This was the third incident of breaking of pipelines carrying effluent.
9.	28.09.08	There was a massive gas leak of HCFC 22 (Hydrogenated Chloroflouro Carbon 22) from Chemplast Plant I. The leak lasted more than an hour. People experienced severe nose and eyes burning and a bitter, bilious taste in their mouths, inducing them to spit often.
10.	21.02.09	A worker, P. Thangaraj (23 years) had to have his left leg amputated after a massive explosion at Chemplast's Metkem Silicon plant in Mettur Dam crushed the victim's limb.
11.	11.03.09	A tanker carrying toxic effluents from Chemplast Sanmar was caught by villagers while discharging its contents into a water-body that leads to River Kaveri. It was handed over to Karumalaikudal Police.
12.	11.03.09	There was a leak of chlorine and antimony gas from Chemplast Plant 1. Another occurrence of a leak at the bleach liquor unit in Chemplast Sanmar Plant 3 was reported on the same day.
13.	06.04.09	There was gas leak from Chemplast Plant I (CFC division). Villagers exposed to the unknown chemical reported a decayed coconut odour for about 45 minutes. Villagers experienced eye, throat and tongue irritation and a bloated feeling in the stomach.

*Note- These are only incidents that have been brought to the notice of Gonur West Agriculturist's Development Union, a local farmer's organisation.

Illegal Operations

At present, all five plants of Chemplast Sanmar Limited in Mettur are operating without consent from the Tamilnadu Pollution Control Board. The consents for plant II, III and IV expired in 2008 while the consents for plants I and V expired in 2007. Operating industries without prior consent from the Tamilnadu Pollution Control Board is in violation of the Air (Prevention and control of Pollution) Act 1981 and Water (Prevention and control of Pollution) Act 1974 and are prosecutable offences under the Acts.

Evidence of Contamination from the TNPCB

Sample Analyses done by Tamilnadu Pollution Control Board proves extensive chemical contamination due to Chemplast Sanmar's operations in Mettur. The following tables are extracts from TNPCB's sample analysis collected in and around Chemplast Sanmar, Mettur by TNPCB on 17 December 2007.

Table 1: Report of analysis of water samples showing presence of chemicals above standards in wells in Mettur

Chemicals	Open Well owned by Chinnu ug/l	Borewell owned by Nalla thambi ug/l	WHO's Guidelines for Drinking water Quality ug/l	International Agency for Research on Cancer – Evaluation of carcinogenic risks to Humans
Chloroform	19.94	17523	200 µg/l	possibly carcinogenic to humans (2B)
Bis-2Ethylhexly Phthalate	34.46	47.64	8 ug/l	not classifiable as to its carcinogenicity to humans (3)
Methylene Chloride	59.32	11.69	20 µg/l	possibly carcinogenic to humans (2B)
Vinyl chloride	77.02	20.61	0.3 µg/l	carcinogenic to humans (1)

http://www.who.int/water_sanitation_health/dwq/chemicals/vinylchloride.pdf

<http://www.lenntech.com/WHO%27s-drinking-water-standards.htm>

<http://monographs.iarc.fr/ENG/Classification/index.php>

Table 2: Report of analysis of effluent samples showing presence of chemicals above standards in effluents discharged by Chemplast Sanmar into River Kaveri

Chemicals	Final Outlet of final collection tank inside the Chemplast Plant II - ug/l	Treated effluent discharged into surplus water of Cauvery by Chemplast Plant II ug/l	Treated effluent discharged into surplus water of Cauvery by Chemplast Plant III ug/l	WHO's Guidelines for Drinking water Quality ug/l	International Agency for Research on Cancer – Evaluation of carcinogenic risks to Humans
Benzene	189	ND	ND	10 µg/l	<i>Carcinogenic to humans (1)</i>
Chloroform	508	3.2	629	200 µg/l	Possibly carcinogenic to humans (2B)
Ethylene Dichloride	398	195.4	245	30 µg/l	<i>possibly carcinogenic to humans (2B)</i>
Methylene Chloride	96.48	ND	1187	20 µg/l	<i>possibly carcinogenic to humans (2B)</i>
Vinyl chloride	45144	20445	63.8	0.3 µg/litre	<i>Carcinogenic to humans (1)</i>

www.who.int/water_sanitation_health/dwq/chemicals/vinylchloride.pdf

<http://www.lenntech.com/WHO%27s-drinking-water-standards.htm>

<http://monographs.iarc.fr/ENG/Classification/index.php>

Table 3: Report of analysis of water showing excessive salt contamination in wells

Parameter	Total Dissolved Solids (TDS)	Chloride
Water Sample collected near salt storage of plant III on land owned by Madhu	4254 mg/L	2057 mg/L
Open well owned by Kunjan at Kunjandiyur	5506 mg/L	919 mg/L
Open Well owned by Arthanari, Kunjandiyur	6658 mg/L	3688 mg/L
Open Well owned by Arthanari, Kunjandiyur		7510 mg/L
Open well owned by K.R Sathiyappan, P.N.Patti	5362 mg/L	3023 mg/L
Open well owned by K.R Sathiyappan, P.N.Patti	-	5448 mg/L
Effluent Sample collected near salt storage yard	3324 mg/L	2025 mg/L
WHO's Guidelines for Drinking water Quality mg/l	No guideline	250 mg/l
USEPA - Secondary Drinking Water Regulations	500 mg/L	250 mg/L

<http://www.lennntech.com/WHO%27s-drinking-water-standards.htm>

<http://www.epa.gov/safewater/contaminants/index.html#mcls>

The Tamilnadu Pollution Control Board has issued show cause notices to Chemplast Sanmar through the years as their treated effluents were not meeting the effluent standards.

Table 4: Health Effects on humans of the chemicals detected in Mettur's environment

S. no	Chemical	Behavior in the Environment	Route of Exposure (ingestion/ inhalation/ Skin)	Health Effects
1.	Benzene (Natural)	Benzene can pass into the air from water and soil. It can pass through soil into ground water.	Inhalation & ingestion	Affects blood, bone marrow, and immune system. Causes anemia.
2.	Chloroform (natural)	Chloroform evaporates easily into the air. The breakdown process in air includes phosgene & hydrogen chloride, which are both toxic. It doesn't stick to soil very well and can travel through soil to groundwater. Chloroform lasts a long time in groundwater.	Ingestion, inhalation & through skin.	Irritates the eyes. Causes effects on the central nervous system, liver, and kidneys. The liquid defats the skin.
3.	Bis(2-Ethyl hexyl) phthalate (synthetic)	Does not evaporate easily or dissolve in water easily, attaches strongly to soil particles.	Inhalation, ingestion, & through the skin.	Affects testes
4.	Ethylene Dichloride (synthetic)	It evaporates very quickly from water into the air. In air, it is readily broken down by sunlight.	Ingestion, inhalation & through skin.	Affects nervous system, kidneys, and liver. Inhalation may cause lung oedema. May cause dermatitis.
5.	Methylene Chloride (synthetic)	Methylene chloride does not easily dissolve in water, but small amounts may be found in drinking water. It is poorly absorbed in soil but it can travel through soil to ground water where it may persist for years.	Inhalation and ingestion	Irritates eyes, skin & respiratory tract. Repeated or prolonged contact with skin may cause dermatitis. May have effects on nervous system and liver.
6.	Vinyl Chloride (synthetic)	Vinyl chloride released to soil will either quickly evaporate, be broken down by microbes or may leach to the groundwater.	Inhalation	Irritates the eyes. May have effects on liver, nervous system, spleen, tissue and bones of the fingers

Annexure 2

Chemplast Sanmar Limited

Chemplast Sanmar has been operating in Mettur since 1965. Its manufacturing operations at Mettur are divided into four units; additionally, another unit is operated by a joint venture Cabot Sanmar to produce fumed silica.

S.No	Unit of Chemplast Sanmar	Products Manufactured	Raw Materials Used by the Plant
1.	Plant I	Potassium Bromide, Sodium Bromide, Bromine, Hydro Bromic Acid, HCL acid, Trichloro & Di Chloro Mono Flouro Methane, Mono Chloro Di Flouro Methane,	Carbon Tetra Chloride, Chloroform, Hydrogen Fluoride
2.	Plant II	PVC Resin, HCL acid, Ethylene, Ethylene Dichloride, Vinyl Chloride Monomer	Ethyl Alcohol, Chlorine
3.	Plant III	Caustic Soda, Chlorine, Hydrogen, HCl 30%, Bleach Liquor, Methyl Chloride, Methylene Chloride, Chloroform, Carbon tetra Chloride, Tri Chloro Ethylene, Calcium Hydroxide, Tetra Chloro Ethylene, Silicon tetra Chloride, Ethyl Silicate, Trichloro Ethylene, Perchloro Ethylene, Dichloro Ethylene, Acetelene	Salt, Lime, Methanol, Dolomite
4.	Plant IV	Pure Silicon (metal), Semi conductor Silicon	Silicon, Hydrogen
5.	Plant V	Fumed Silica, Chlorosilicones, HCL acid, Sodium Hypo Chloride Liquor, High Boils	