The Need to Share International Research and Data On Health & Safety Issues.

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Abstract
Health and safety issues have always been at the forefront of international co-operation within the composites industry as they have perhaps the greatest potential to curtail the growth of the composites industry worldwide.

In this age of rapid international communications, Government regulators around the world communicate amongst themselves. If we as an industry expect to have reasoned debate with them in setting regulations that protect workers health and that are realistic, then we must be prepared by also communicating effectively.

The larger countries provide the majority of the research and data. Other countries can also contribute by sharing whatever data they have, for example on how their legislation is shaped and implemented.

This paper outlines effects based legislation that has been put in place in New Zealand and how this affects the New Zealand composites industry. The Composites Association of New Zealand has just recently published a Code of Practice for composites manufacturing that assists employers meet their obligations to legislation. Some of the important aspects of this Code of Practice are discussed.

Finally this paper gives an example of monitoring health and safety of employees and highlights some of the problems our industry faces in interpreting data and acting on it.

Introduction
At the first meeting to set up a worldwide reinforced plastics-composites institute, one of the key workshops was on health and safety (ref. 1). The styrene issue has always been perhaps the biggest issue the industry has had to face worldwide. Questions asked then are still far from answered. Some of these questions were:

(1) How can the health of workers be protected?
(2) What safety programmes are available in what countries?
(3) What new health and safety regulations are needed?
(4) How are Government health and safety regulations implemented worldwide?

Regulations put in place to protect the workers must be realistic and appropriate. There is little point in protecting the workers health so much that it is impossible for a business to operate to employ that worker.

In any one country, even a small health and safety incident in one composites plant will have an effect on all composites plants in that country. A major health or safety incident somewhere in the world could have an effect on every composites business worldwide. Health and safety issues have perhaps the greatest potential to curtail the growth of the composites industry worldwide.

International Communications
Such is the shrinking size of the world in this age of international communications, that decisions made in countries such as the USA and Sweden, are quickly known

everywhere around the world. If for example new tighter styrene levels are set in either of these two countries, then these new levels can be and often are quickly applied in another country, often without proper debate. The effect of this can be disastrous if the regulations are applied for the wrong reason and without sufficient time for proper debate and time for businesses to restructure.

Government regulators around the world communicate amongst themselves. There are international meetings and conferences on these topics. If we as an industry expect to have reasoned debate with Government regulators in setting regulations that protect workers health and that are realistic, then we must be prepared by also communicating effectively.

International Research and Data

The larger countries provide the majority of the research and data. Other countries can also contribute by sharing whatever data they have. Different governments take different approaches to legislation and regulations regarding health and safety issues. Information on what legislation is in place and how it is implemented in different countries is of use to other countries struggling with the same problems. Codes of practice approved for use in a country to provide guidelines for industry and to provide for the health and safety of workers can be shared.

The Internet now makes lots of data available to anyone who wants to search for it.

New Zealand Legislation

New Zealand is moving towards effects based legislation, rather than prescriptive legislation. Government agencies see it as their duty to specify outcomes rather than tell business what they must do on a day by day basis. Recent legislation is:

(1) Resource Management Act 1991. This environmental legislation's objective is to protect the environment. In general terms it says that no one can discharge something to the environment that will have a negative effect on the environment. For the composites industry, the major impact is that a company cannot causes an objectionable styrene odour beyond its boundary.

(2) Health & Safety in Employment Act 1992. The principal object of this Act is to prevent harm to employees at work. To do this it imposes duties on, and promotes excellent health and safety management, by employers. It also provides for the making of regulations and codes of practice. For the composites industry, the major impact is that if an employee becomes ill due to say styrene inhalation, then the company can be prosecuted. If the company has not followed accepted best practice, then a conviction is likely.

(3) Hazardous Substances and New Organisms Act 1996. This legislation is designed to protect the community from the effects of these materials. The effects on the composites industry are still not clear, but all products that are hazardous or toxic must be registered with the Government body.

In essence these Acts say that if a particular company causes a problem with either the community, the environment or a worker, then that company will face prosecution with a penalty of a monetary fine or even possibly imprisonment of directors. The only real defence against this prosecution is for that company to provide data on health and safety issues from around the world showing that the company has acted properly in line with accepted practice worldwide. In so doing the company needs to show that they had taken every precaution they could have to prevent the incident occurring.

New Zealand Styrene Levels

The current workplace exposure standards in New Zealand as at June 1998 for styrene monomer are (ref. 3):

STEL (short term exposure limit)	100 PPM. Applies to a 15 minute period.
TWA (time weighted average)	50 PPM. Applies over an 8 hour period.

New Zealand Code of Practice for Composites Industry

The Composites Association of New Zealand has this year published a Code of Practice for the New Zealand Composites industry (ref. 4). The code is a joint effort between regulatory bodies and industry representatives. The code was over 15 years in the making and at times we thought we might never see it published. The code is not legally binding and compliance with the code is not mandatory. The code is a statement of preferred work practices and arrangements. The code may be used as evidence of good practice in court, for example to defend a prosecution.

The majority of the code is common sense and brings together a lot of useful facts and figures. It is designed as much to assist the small composites operator as it is to educate the regulatory inspector who is charged with ensuring a composites factory is in compliance with regulations.

One of the more difficult areas addressed was how to classify the working area where the polyester resins are used in a composites factory, particularly with regard to fire and explosion and the use of electrical tools. The approach agreed upon was that if:

(1) the health and safety provisions of the code are observed; and
(2) the level of vapours is kept below 25% of the lower explosive limit; and
(3) products such as acetone are stored properly as set out;

… then the area can be classified as non-hazardous for the purposes of electrical classification and fire and explosion. This allows the use of electrical tools and motors that are not “explosion proof”. A similar approach using the level of 25% of the lower explosive limit of vapours has been independently taken in the USA with the fire code chapter dealing with composites manufacturing (ref. 5).

The ongoing task of monitoring the health of workers has been addressed with two broad statements:

(1) In general it can be assumed that concentrations below 10% of the worker exposure standard will not present a significant risk to health.
(2) It is recommended that where the concentrations exceed 50% of the worker exposure standard, monitoring of employee’s health should be done.

Measurement of Worker Exposure to Styrene

The accurate measurement of the time weighted average levels of styrene that a worker is exposed to is not simple. Continuous monitors attached to workers do not sample the actual air just before it enters the worker’s lungs as the monitor cannot be placed in the workers mouth. Workers rarely remain in one place where the styrene level is constant for long. On the other hand, regulatory inspectors have been known to enter a composites factory and upon smelling styrene, declare that the whole building is likely to explode! Then they take one impinger measurement for styrene monomer with the impinger placed right beside a wet laminate, see that the styrene level is off the scale, and declare the place exceeds worker exposure standards. The author has yet to hear of a time weighted sampling system that gives acceptable and accurate results. Yet exposure standards in every country are based on time weighted average levels of exposure!

Health Monitoring Programme
As part of the health and safety programme at the author's company, ten workers submitted urine samples at the end of a standard 40 hour working week for testing. The following results were obtained.

Worker	Mandelic acid	Volatile solvents	Comment
No. 1	36 mg/l	None	Over 15 years in industry
No. 2	11 mg/l	940 mg/l ethanol	Non work exposure … party!
No. 3	170 mg/l	None	New worker
No. 4	9 mg/l	None	Over 10 years in industry
No. 5	40 mg/l	None	
No. 6	150 mg/l	None	
No. 7	53 mg/l	None	
No. 8	45 mg/l	None	
No. 9	70 mg/l	None	
No.10	230 mg/l	None	Work habits need addressing

NB: Tests for mandelic acid are non-specific and can be prone to interferences.

When faced with these results for mandelic acid, no one could initially tell us what they meant. Our health care advisor and medical practitioners could not initially agree on what the figures should be, and what we should do about it. Many months later the local Department of Health officers advised that a mandelic acid level in urine of below 1,000 mg per litre was acceptable (ref. 3).

The one worker with ethanol in his urine had been at a party the night before the sample was taken. Health wise, this is perhaps the most significant result and is non-work related. The worker with the highest mandelic acid result has the habit of putting his face close to a laminate when rolling it out. Knowing these results he is now adjusting his work practices.

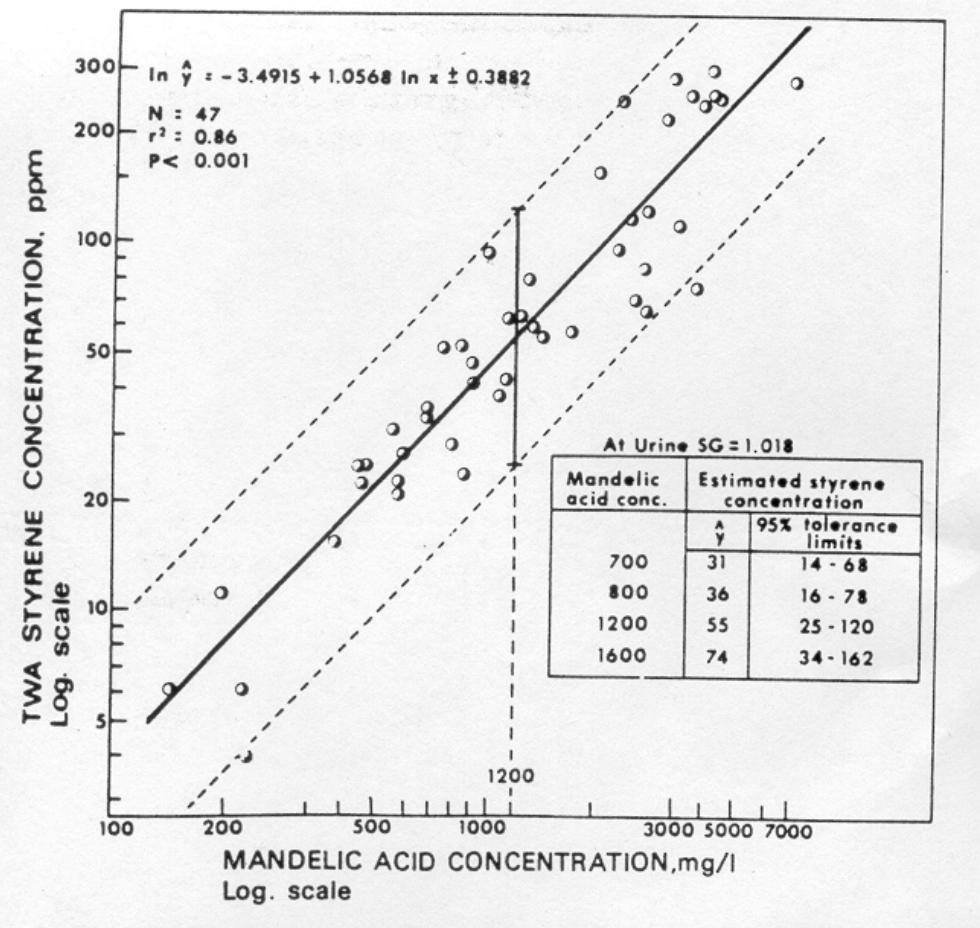
Assistance from International Data …NIOSH
At that time the author obtained the USA Department of Health and Human Services NIOSH (National Institute for Occupational Safety and Health) publication on exposure to styrene (ref. 2). This publication was originally published in 1983 and contains a lot of data on exposure to styrene. It contains reports on studies done in many different countries on styrene exposure to workers and laboratory animals. In general terms, the author read that whenever the time weighted average exposure was less than 100 PPM, there were very few ill health effects.

The NIOSH publication (ref.2) gives evidence that a workers time weighted average exposure to styrene can be effectively monitored by doing a urine analysis for mandelic acid at the end of a working week (see fig. 1) to determine the styrene exposure level. The NIOSH publication provides evidence that this method is more accurate than doing continuous gas monitoring. From fig.1 it can be inferred that if the mandelic acid concentration in the urine samples is below 600 mg per litre, then there is 95% confidence that the workers exposure to styrene monomer for the week prior was below 50 PPM.

Applying fig. 1 to the analyses of the urine samples from workers at the authors company, it is concluded that, on the basis of the highest mandelic acid result of 230

mg/litre, the maximum time weighted average exposure to styrene was 10 PPM (range of 5 to 20 PPM). This is below the New Zealand worker exposure standard of 50 PPM.

Fig. 1: Mandelic acid in urine versus styrene TWA concentration
Source: NIOSH (ref. 2)



Assistance from International Data …ACGIH

The American Conference of Government and Industrial Hygienists (ACGIH) in their 1997 publication (ref. 6) set the time weighted average exposure of styrene at 50 PPM and the level for mandelic acid in urine at 800 mg per litre. It is also understood that the ACGIH have proposed to lower the exposure level of styrene to 20 PPM in the near future. Does this mean the mandelic acid in urine level will be reduced as well?

More Accessible Up To Date Information Is Needed

We should be using more up to date information than that published in 1983 by NIOSH (ref. 2) to protect the health of our workers. Is there more data available now? If there is data available how can we access it? When the tests were done at the author's plant there was little data readily available upon which to base decisions. During the course of researching and writing this paper, additional data has been found and used. For the average small composites' fabricator in any country it is difficult to obtain this data and to interpret it. With levels of styrene under review internationally, what changes will this mean in the future? How will the average composites' fabricator find out about this?

For the future of our composites industry we must obtain and share more data. Fabricators will look to national composites associations for assistance, and the author urges national composites associations to co-operate and share data.

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