

## **Author's response to reviews**

**Title:** Source Reduction for Prevention of Methylene Chloride Hazards: Cases from four industrial sectors

### **Authors:**

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PDF covering letter

## C. Roelofs Responses to Comments

Reviewer #1 Prof. Wendy Heiger - Bernays, Boston University SPH

Major Comments on the Paper

1. The title misrepresents the study. Perhaps it should be: Source Reduction for Hazard Prevention: Four cases of methylenechloride reduction.

**Response:** The title has been changed to better reflect the emphasis of the manuscript.

2. The paper's topic is of interest in the occupational, public health, and general environmental communities. However, the work in this paper is more of a status report and program assessment report rather than a research-based study. Thus it is useful in that it identifies the major obstacles faced by four companies that decreased or eliminated use of methylenechloride in its processes.

**Response:** The methods section has been augmented per Dr. Strunin's suggestion to clarify the value of qualitative methods and the case study approach as research.

3. The purpose or underlying hypothesis and approach need to be more clearly presented.

**Response:** Qualitative research strategies are generally not guided by hypotheses as much as a theory, a method of inquiry and a set of research questions. I have tried to clarify discussion of these in the intro and methods section.

1. Methods

Major Comments/Methods:

a. Cases were selected. Criteria for inclusion of cases were not explicit. How many companies were solicited (filed Form S), how many filed Form S, but would not participate? Thus it is difficult to determine whether these companies were "selected" by default. Reference is made to "multiple data sources" - what are these?

**Response:** A full description of the case selection and data sources is now included.

b. A definition of the "use" of methylenechloride should be provided. Does "use" refer to frequency or volume, or other measures? Does it differ depending upon the case investigated?

**Response:** Use was defined in the manuscript in terms of volume (companies that used more than 10,000 lbs/yr reported use under the Toxics Use Reduction Act) and by type of use - in an industrial process, not as a product component. This has been further clarified by giving examples of use.

c. In some cases minimal environmental sampling accompanied the analysis, although in those cases it is unclear whether samples were taken pre- or post-methylene chloride process modifications.

**Response:** This has been clarified.

In Case #1, what does "expanded aqueous cleaning with the new chemistry" mean?

**Response:** Clarified

Also, what are the toxicological properties of the alkaline cleaner?

**Response:** These were discussed in detail in the original paper, p. 13

Presumably the TW A sample taken was prior to replacement of methylene chloride with the new cleaner? Why was sampling post-replacement not possible?

**Response:** Clarified. Also, exposure conditions did not change pre to post. What changed was the time of potential exposure and this is detailed in the paper. So, given limited resources it was determined that post-intervention sampling would not give additional information.

d. After the methylene chloride replacement/decrease use, documentation of the environmental conditions was not made, or was based on conversation with company managers. Were production records or purchase orders reviewed that document the replacement?

**Response:** In addition to conversations with company person (the source of most of the data in these case studies), site visits were conducted where I personally observed the new processes with the new chemistries. Additionally, these companies' Toxics Use Reduction Act reporting records were reviewed and confirmed the reduction in use of MC. These companies voluntarily reduced or eliminated MC, were glad to be rid (or have less of it) and would have little motivation to "sneak" it.

e. How are the new processes evaluated?

**Response:** For each company this is described in both the process section and the assessment section. It varied for each company and short-comings in their evaluations are noted. For example, for the metal finishing company, I wrote "Technical and performance criteria dominated the evaluation process. Because the aqueous cleaners had few reported health or safety hazards, especially in their diluted form, Material Safety Data Sheets (MSDS) were the only resources consulted by the company to gain information about potential environmental, health or safety concerns." Most companies had less than complete evaluations – that was a key finding of the study as noted in the discussion.

Does replacement with an alternative process that has not been well characterized (case #1) qualify as toxic user reduction? Is there a metric that could be used to determine this?

**Response:** This is an interesting question that goes to the heart of risk assessment (how do we prove that something is not hazardous/toxic?). I'm glad that it occurred to the reviewer and I hope that it occurs to the readers. I

concluded that given the information that we had (which I shared with the reader), toxic user reduction had been achieved. I believe that most in the field would agree that dilute alkaline detergents are less toxic than MC. I also argued that in the use described, the new process was also less hazardous. However, I also reminded readers about the lack of information about new chemistries. I have added a table summarizing the toxicity info of the substitutes.

DBE exposure by the company is not considered to be a hazard. Who decides this? Is there an exposure limit?

**Response:** The objectives of the study were to describe the companies' perspectives, not to correct them. I clarified that there is no exposure limit (which would not be a very good indication of hazard anyway.) I share the reviewer's frustration with the real world of hazard assessment and am glad that it was conveyed.

f. Health effects of methylene chloride are treated by drivers of this reduction, however the replacements (chemicals & physical hazards) are not dealt with objectively between the four cases. For example, is replacement of a "probable" carcinogen with a reproductive hazard better? There necessarily needs to be a discussion of exposures and protections. The same level of analysis or discussion should be given for all replacements.

**Response:** Each section on the environmental and health and safety assessment details post-process change exposure issues including toxicity and exposure conditions (likelihood of exposure, volatility of the substitute, potential for dermal exposure and personal protective equipment). Additionally, hazards that were introduced as a consequence of the change (including those not related to the toxicity of the substitute, such as noise of a new process) were also described. My view is that hazard assessment in the real world is not an objective science even when we have all the information, which these companies did not. I described the judgments made by the companies and tried to give my view of the impact of the changes – both positive and negative. A key finding of the study is that source reduction can introduce new hazards that are not well characterized or addressed by the companies and, thus, more assistance and oversight by occupational health professionals should be provided. With regard to the substitute NMP, I am clear that this was sub-optimal, although given the reduced exposure potential, probably an improvement.

## 2. Result s&Conclusions

a. The results of this study are not presented clearly and are partially incomplete. This reviewer had difficulty drawing conclusions based on the presentation of the cases. A summary or table or graphic would certainly aid in the reader's ability to do this.

**Response:** A table was added and the results clarified.

b. While the focus is on companies that use (or had used) methylene chloride, it does have wider implications as presented in the discussion. The paragraph that begins with Š

Companies were strongly motivated by environmental compliance and goals. Isn't this a major finding that could be more strongly presented since it is based on these 4 cases?

**Response:** This finding is in the abstract, the individual cases and the conclusions. I was not deemed to be a more significant finding than the fact that the companies were successful, largely, though need help.

c.p.29 Did all four companies really lessen potential exposure to hazardous chemicals? This study examined only one part of the process - that in which methylene chloride was used. So, until analysis is made of the workplace, one can conclude that four companies lessened exposure to methylene chloride.

**Response:** Changed in line with comment.

#### Minor Comments

d.p.12 1st sentence, 2nd paragraph: are workers potentially over-exposed compared with the OSHA PEL? Changed

e.p.13. what is the Hof the diethyl glycol ether? You stumped me on this one. I searched several sources and all say "Information not available." (CAS No.: 11234-5) I'm thinking neutral. It is about 5% of the concentrate which is used at 10% (or less). I'm thinking that the sodium metasilicate that has a higher pH is probably the main contributor to the alkalinity of the total product with is reported here as around pH 13. A statement is made about the pH of the fumes. What are the hazards associated with the alkaline cleaner? Described in text and new table.

f.p.11. First sentence of the paragraph that begins "Technical, environmental, health and safety and financial assessment" is unclear. What does this mean? Clarified

g.p.14 Process & Source Reduction - toxicity of DBE? Described

h.p.178. Are there any data that document that occupational exposure to DBE is below the occupational exposure limit? The process that the company used to determine exposure potential in comparison with the manufacturer's guideline is described. There is no PEL for DBE.

i.p.22. Is there an exposure guideline for NMP? Who asked the worker about use of NMP (employer or investigators)? Is this complaint more widespread? Is there an implication of this complaint in terms of worker protection or is the elimination of methylene chloride more important? There is no PEL for NMP. The investigators spoke with the only worker who performed the process. I don't understand the last question.

j.p.23. Is Freon 141b more or less volatile than methylene chloride and the implication of this? What are the health effects (generally) to which you refer? Health effects and physical properties and exposure potential are described.

k.p.25. The change in practice reduced the hazardous waste cost to \$70/tote - from what? Fixed.

l. Is the cost of the hazardous waste disposal included in the 4th case for savings?

**Yes, Table 4.10: Cost Comparison Per Tote --DC Mvs. Baking Soda Blast**

	DCM	Baking Soda
Tyvek Coveralls	\$100	\$10
Respirator/Air	\$100	\$10
Chemicals	\$30	\$50
Labor	\$750	\$200
Waste	\$250	\$50
<b>Total</b>	<b>\$1,230</b>	<b>\$320</b>
<b>Savings Per Tote</b>	<b>\$910</b>	

Source: Company communication.

m.p30. This reviewer doesn't understand the 1st sentence of the second paragraph: "Generated a rich, triangulated dataset." Fixed. A reference is made on p31 (conclusions) to source reduction changes in this sector and others, although no references are represented. Was referring to our study – clarified in the text.

Level of interest

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 A paper whose findings are important to those with closely related interests. In particular, these are relevant for policy modification and economic initiatives to industries for toxic substance user reduction.

Quality of written English

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 The paper is written in a tone that conveys disgust with the lack of encouragement for toxic user reduction in industrial settings. The non-technical writing style is acceptable for publication where American jargon is understood, but probably shouldn't be used for an international on-line journal. In two of the cases, quotations from employees are presented that could be harmful to their employment status. Acronyms are used without definition (e.g. NMP) and there are a few typographical errors.

**Response:** European environmental scientists, and in particular, Scandinavians, are much more advanced than US with regard to pollution prevention issues. I have eliminated jargon where possible. With regard to the quotes – potentially a very serious concern. However, the reviewer did not identify which quotes she felt to be of concern. In two cases, members of senior management were interviewed and in the other two cases the company presidents were interviewed. The investigator does not believe that the interviewees' employment status is vulnerable even if the companies could be identified. On Jargon: All abbreviations were defined in the original, but I have eliminated abbreviations in line with this and the other reviewers' comments.

Summary

This paper presents the reduction in methylene chloride use in four companies in Massachusetts. It is not really about methylene chloride exposure, nor is it a rigorous case study of the companies investigated, nor does it give examination to toxic substitution. The conclusion of the report identifies the major motivator to source reduction in these

companies. This is important and is applicable beyond Massachusetts. The paper is more a report, rather than findings of a research study.

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Reviewer#2, Prof. Gerard Zwetsloot, Erasmus Centre for Environmental Studies  
Erasmus University Rotterdam

1. Are the conclusions drawn adequately supported by the data shown: if not, what are the shortcomings and could they be overcome?

Yes, they are adequately supported. However, the conclusions can be formulated stronger than in the submitted version. In my opinion, the cases do not suggest that source reduction strategies can be feasible, but they clearly demonstrate it. Probably the words suggest is used, because it is not possible to generalise this to other cases. That was our perspective.

2. Are sufficient details provided to allow replication of the work or comparison with related analyses: if not, what is missing

Yes

3. Does the manuscript adhere to the relevant standards for reporting and data deposition: if not, in what ways?

Yes

4. Is the writing acceptable?

It is acceptable. However, there are too many abbreviations in the text.

Sometimes it is necessary to know the Massachusetts administrative procedures, to fully understand the article, e.g. on page 7 where Form S under TURA is mentioned; this form is not known for the majority of the readers. Jargon and abbreviations have been eliminated.

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Reviewer#3, Prof. Lee Strunin, Boston University SPH

These comments focus solely on the methodology section.

Try to strengthen the discussion of qualitative methods. This is a chance to acquaint readers with the distinctive value of this approach and I would advise more discussion of exactly what the methods contribute that quantitative research cannot. Some additional references would be helpful for the reader not familiar with, or convinced about, the utility of qualitative methods. Done

Explain more about the use of multiple data sources and describe the contribution of each data source to the findings. The reference to the interview guides following Patton's qualitative evaluation guidelines (page 7) should be more fully explained as should the explanation of case studies (page 8). Done.

Concerning the interviews, explain or describe interview procedures (were they semi-structured; open-ended?), the construction of the interview questionnaire, the timeframe of the interviews, how and who coded the data, intercoder reliability, and how the data was analyzed. Explain how many interviews were conducted and why were some telephone and others in-person and whether they were the same or different types of interviews. Similarly, explain how many site visits were conducted, what happened at the site visits, what information was collected at site visits. In the results section the data sources for the first case are described but not the sources for the other cases.

**Response:** Dr. Strunin's recommendations were incorporated into the background, methods and results sections. In particular, I have given much more detail about how this study, in particular, was conducted. While even greater explanation and detail could have been given about the methods in general, I felt that devoting a lot of space to this would distract from the results of this particular study. So, I hope that I was able to "show" as well as "tell" about the value of the methods.