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Letter to the Editor

RE: Fuels in Sewers: Behavior and Countermeasures (M. Fingus et al.)

Science *or* Selective Graphing

Dear Editor:

In 1988, a study conducted at Environment Canada's (EC) Research Center in Ottawa, endeavored to understand fuels' behavior in a closed conduit or sewer while attempting to quantify the effects of emergency response countermeasures. An article was submitted to the *Journal of Hazardous Materials* (Journal) for publication in May of 1988. As standard practice, the Journal has all reports, technical data, and laboratory studies reviewed by a panel of professionals who accept or reject a paper on its merit. The information was accepted July 10, 1988 for publication. Since that time, there has been much debate among federal and state regulators as well as various fire authorities as to the declarations, conclusions and recommendations this study promotes.

The ''*Fuels in Sewers*'' article was based on a large series of test runs through a man-made ''sewer''. Several chemical countermeasures were tested at various dilutions and velocity rates. Most of the testing was conducted with unleaded regular gasoline while a smaller battery of tests involved automotive diesel fuel. Each test run involved 1 ml of the appropriate test fuel. The ''sewer'' was 104 m long, 3.8 cm in diameter with PID monitoring stations at logarithmic intervals (4.5 m, 9 m, 18 m, etc.) and designated as stations 2, 3, 4, etc. The complete study involved approximately 160 test runs. The data was then tabulated and recorded. The authors selected their portions of the data from the large series of test runs, charted them, and submitted the article to the Journal for publication.

EC's research first identified the behavior tendencies of the fuel itself. One very significant event demonstrated how fuels volatize in sewers. As the chart in Fig. 1 illustrates, fuels have two volatile fractions. The first is the immediate volatilization that occurs upon the inception of a spill. This is graphed as the *second* peak in the chart. This volatilization usually occurs before an emergency response crew could even arrive at the scene. The second volatilization of the fuel is labeled the ''boiling fraction.'' This is illustrated as the *first* peak. (See Fig. 1.) This fraction volatizes as the fuel travels down a sewer line. EC then charted the two fractions as the fuel traveled down the sewer. In one test the fuel was unhampered while the second test involved a ''dispersion'' or chemical countermeasure. (Figs. 1–3).

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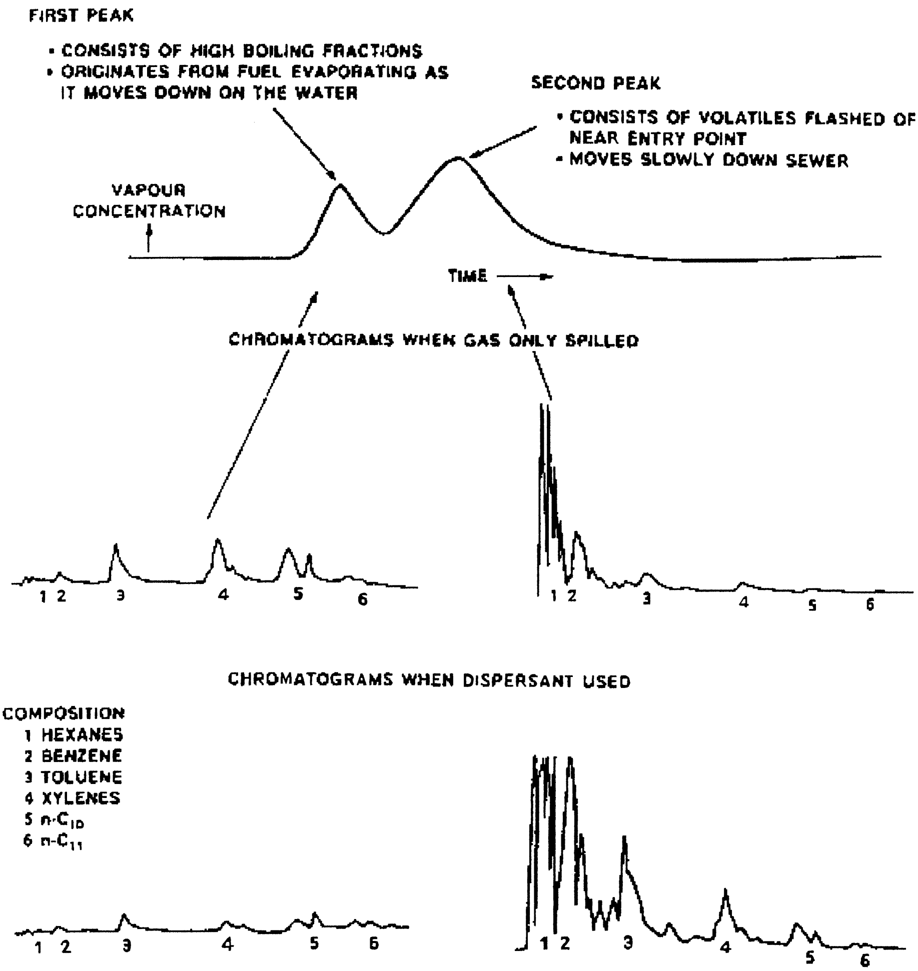

Fig. 1. Origin and composition of vapour peaks in a sewer.

The article indicated that the treated volatile fractions (second peak) showed an initial increase in vapor release. This was attributed to the surface tension reduction by the surfactants. However, since there was no baseline data on the chemical countermeasures, it is difficult to attest as to how much the chemicals themselves may have affected the vapor increase as registered by the PID. The article notes that of all the chemical countermeasures tested the fluoroprotein foam had the highest *increase* in vapor release. This is extraordinary because foams have been the first line of defense for hydrocarbon vapor suppression for the last 50 years.

Another significant discovery was the *reduction* in the treated fuels' boiling fraction vapor release (first peak) as it traveled down the ‘‘sewer’’. The dispersed fuel had a considerable decrease in the release of new vapor. The authors do not investigate the

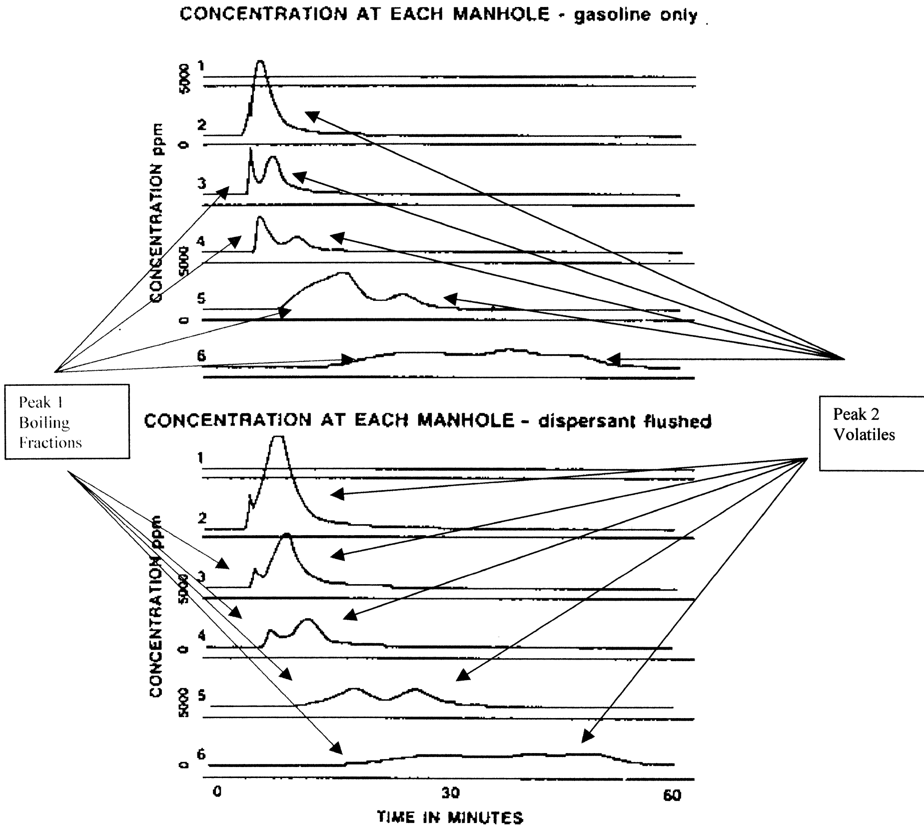

Fig. 2. Real time display of vapour concentrations.

vapor reduction, but state only that: ‘‘*compounds smaller than toluene are largely removed from vapour peak 1 when dispersants are used*.’’

The article then declares that the use of dispersants ‘‘*increase(d) the amount of vapors in every case*.’’ They concluded: ‘‘*That the use of dispersants will, in fact, increase the potential for and the magnitude of explosions from fuels spilled into sewers* . . .’’ The ultimate recommendation of the authors was to pump CO_2 into the sewer as *the* effective countermeasure.

At face value, the charts that were published in the Journal seem to support the article’s position. ‘‘In every case’’ the graphs showed that the use of chemical countermeasures increased the vapor in sewers. As a technical confirmation, the authors referenced an earlier paper that they had submitted to ASTM entitled ‘‘*The Behavior of Dispersed and Non-Dispersed Fuels in a Sewer System*’’ (ASTM STP 1018). This study was also submitted in 1988 and was ‘‘in press’’ at the time of the Journal’s publication. ASTM supplied us with the study that contained the summary data so that we could substantiate the author’s assertions in the article. Since there was no summary data

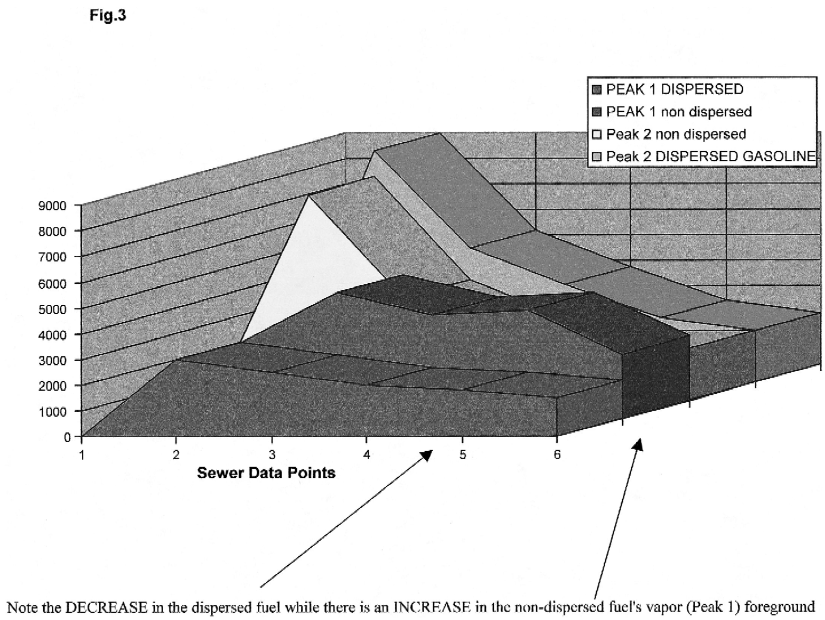

Fig. 3.

included in the Journal's article, the graphs were accepted at face value. The information received from ASTM contained no graphs, only summary data. Nonetheless, when reviewing the complete and undiluted summary data from the ASTM publication, it appears that the data does not support the declarations, conclusions or recommendations the authors make in their article.

This foundation is strengthened by the inaccuracy or selectivity of the charts as submitted to, and published by the Journal, as compared to the summary data tables as referenced to, and published by, ASTM.

Every chart reviewed contained some sort of inaccuracy or selectivity of data that was not truly representative of the study's broader findings. The EC charts that appeared in the Journal's article either used wrong values (see Fig. 4), or, the selected values charted were not accurately representative of the fuels' or the chemical countermeasures' behavior(s). (Figs. 5 and 6).

The ASTM data reveals that the two agents (Fig. 4) which showed promise or an ability to suppress vapor were both graphed in the Journal's article with appreciably higher values then the actual summary data EC recorded. When correctly charting the summary data of these two agents as supplied by ASTM, both products displayed potential as a chemical countermeasure at dissimilar dilutions and application rates.

Two other graphs were charted using very selective data (Figs. 5 and 6). The authors chose to graph only the lowest vapor values of the diesel rather than any of the substantially higher values recorded in the previous *three* runs. If one chose the higher values, or even the average of the diesel runs from the recorded data, two additional

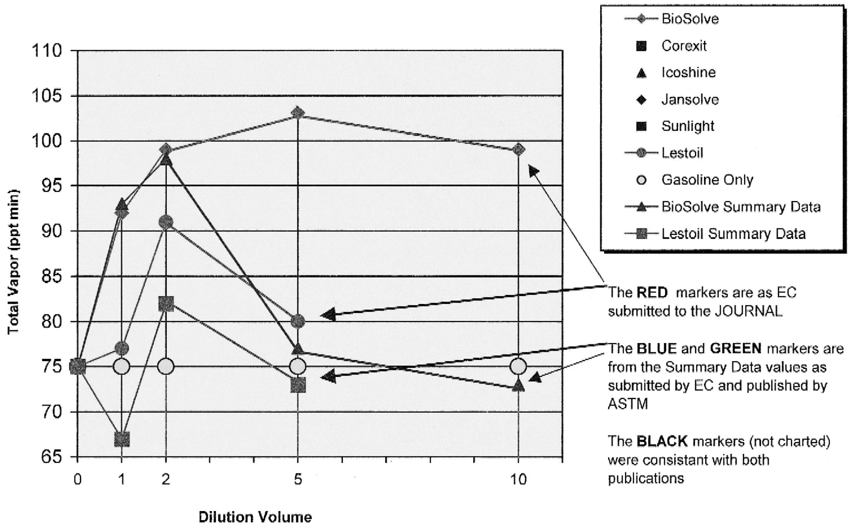

Fig. 4.

products illustrated potential as chemical countermeasures. Based on scientific standards, this article's conclusions now become suspect.

The three accompanying graphs were not the only arguable variations. Other charts were reviewed and similar selective charting became apparent. The authors' selectivity of data that was graphed for the article, seemed more to support a predetermined

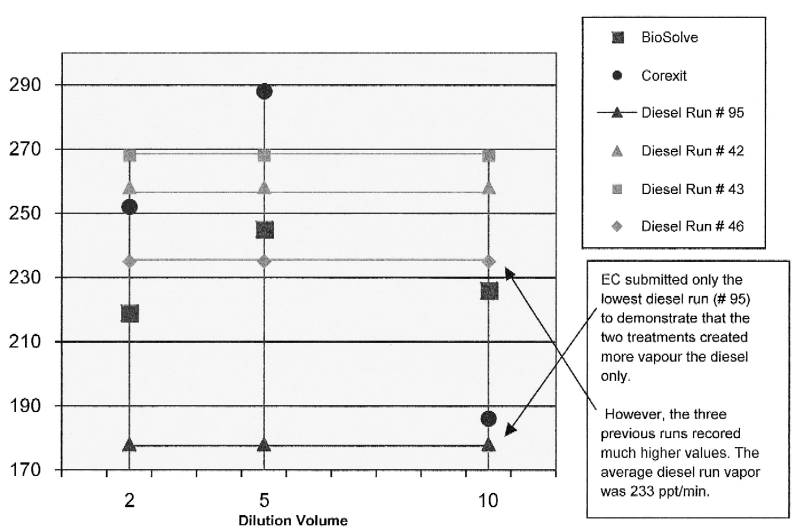

Fig. 5.

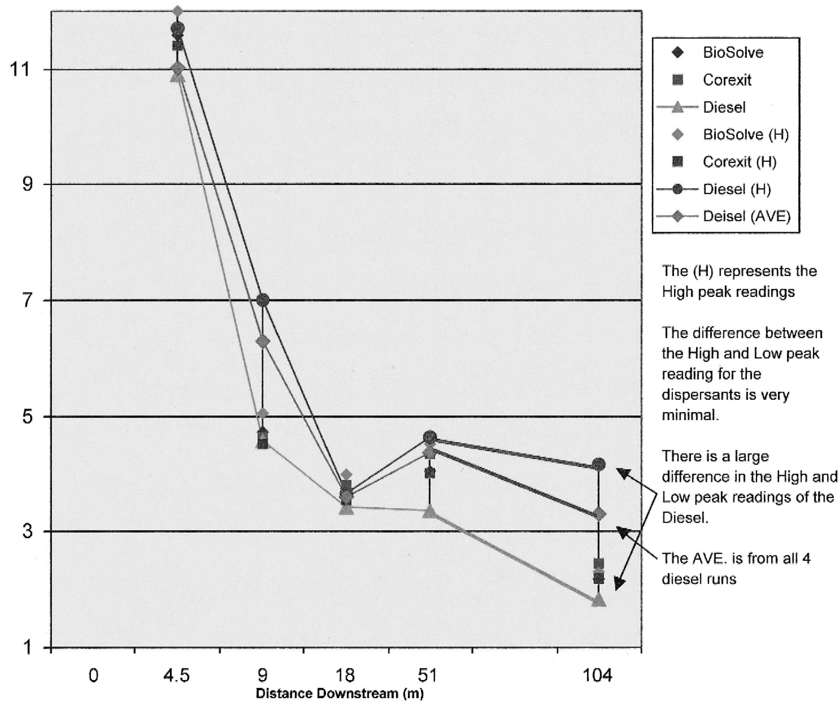

Fig. 6.

hypothesis than it did for attempting to understand the fuels' or potential countermeasures behavior patterns.

We are not addressing the methodology of the tests, which is a completely different discussion, or the acceptability of all chemical countermeasures. We are only pointing out the inaccuracies and selective representation of the summary data figures that were utilized to promote a predisposition. If the correct data had been graphed or broader values from the same study were used, it is unquestionable that the article could have supported an opposing position.

While this study brings to light some very significant behavior tendencies of fuels in sewers, the data does not support the authors' outstanding declarations. The summary data, as supplied by ASTM, does however encourage further investigation of some of these agents as chemical countermeasures for confined space applications.

For several years, the National Fire Protection Association (NFPA) has been reviewing and monitoring these same types of chemical countermeasures in real world applications. These agents have been used to effectively suppress and mitigate fuel spills involving thousands of gallons of gasoline in the sewer systems. In 1998, after input from five different Technical Committees, the NFPA Standards Council established a new Chapter entitled ''Water Additives for Fire Control and Vapor Mitigation.'' With proper application and procedures, these chemical countermeasures have impressed the authorities with jurisdiction and it is these same authorities that comprise this new technical committee.

After all these years, one may ask, why bring this up now? To what importance is a 10-year-old study?

Today, even with these discrepancies pointed out, some regulators and agencies have established policy citing this article in the belief that the information is certified. After all, Environment Canada conducted the study and it was reviewed and published by The Journal of Hazardous Materials.

While these two highly respected institutions influence many regulatory groups throughout the continent, is this article science or is it selective charting?

''*The Behavior of Dispersed and Non-Dispersed Fuels in a Sewer System*'' (ASTM STP 1018) helps in understanding the action that takes place when deploying a chemical countermeasure into a confined space. However, it does not support the authors' assertive declarations or conclusions. When science attempts to understand behavior patterns the facts must be presented without prejudice or bias. The article ''*Fuels in Sewers: Behavior and Countermeasures*'' unfortunately falls short of that principle.

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