



Plastic Pipe and Fittings Association
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April 18th, 2008

To whom it may concern,

This document has been prepared by NSF International at your request. It includes a summary of historical overtime test data for t-butanol as an extractant from cross-linked polyethylene pipe and tubing which have been tested at NSF International to the requirements of NSF/ANSI Standard 61. T-butanol is considered to be a break down product of t-butyl peroxide, which is one of the catalysts that can be used for the cross-linking of polyethylene. It has been requested of NSF International to determine at what point in time during the exposure process would t-butanol reach the State of California's pass/fail action level of 13 parts per billion (ppb).

When testing, the samples are conditioned for 16 days prior to the critical day water collection on day 17. For overtime exposures the water is also collected and analyzed on days 1, 2, 3, 8, 10 and 21. Analyzing water samples from days throughout the exposure is necessary for running the regression analysis. A total of five overtimes were identified and used to summarize the decay pattern of t-butanol. Three different regression models (Power, Exponential and Linear) were applied to the data. From these analyses it was determined that the Exponential model was the most appropriate model to use based upon the coefficient of determination (r^2 value) for each of the five independently run samples. Table 1 summarizes the range of t-butanol levels, by day of exposure, for all 5 samples. Table 2 provides a summary of the overtime testing results for t-butanol.

Table 1. Range of t-butanol levels, by day of exposure, for all 5 samples.

Day of Exposure	T-butanol (ppb)
<i>Day 1</i>	2,000 – 39,000
<i>Day 2</i>	1,400 – 35,800
<i>Day 3</i>	1,100 – 29,500
<i>Day 8</i>	900 – 26,000
<i>Day 10</i>	640 – 23,700
<i>Day 17</i>	310 – 13,200
<i>Day 21</i>	600 – 11,000



Table 2. Results of the regression analysis performed on all 5 individual samples.

Sample	r ² value (Model)	Extrapolated lab day 107 (Day 90) level for t-butanol	Predicted day that t-butanol would reach 12 ppb
Sample 1	0.978 (Exponential)	65.5 ppb	Day 136
Sample 2	0.965 (Exponential)	15.8 ppb	Day 111
Sample 3	0.952 (Exponential)	0.38 ppb	Day 73
Sample 4	0.908 (Exponential)	36.5 ppb	Day 125
Sample 5	0.955 (Exponential)*	0.03 ppb	Day 48

* Day 21 was removed.

These extraction results vary by the amount of peroxide used, the age of the tubing, and the variability that can be introduced during the manufacture of this material. Based upon these 5 test results it is indicated that t-butanol will decay to levels below 13 ppb in as few as 48 days to a maximum of 136 days. For sample 5 the day 21 value was twice the day 17 value. This sharp increase on the final day was considered an outlier and removed. These analyses are based upon 5 independent 21 day overtime tests that suggest the Exponential model most likely fits the real decay pattern of t-butanol. However, we currently do not have any actual long term exposure data to support which model is the most appropriate.

If you have further questions concerning this subject, please do not hesitate to contact me.

Sincerely,

Clifton J. McLellan
Director of Toxicology Services
NSF International