Northfield Mountain Station
99 Millers Falls Road
Northfield, MA 01360
Ph: (413) 659-4489
Fax: (413) 659-4459
Internet: john.howard@gdfsuezna.com

John S. Howard
Director- FERC Hydro Compliance
Chief Dam Safety Engineer

VIA ELECTRONIC FILING

April 15, 2014

Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First Street, N.E.
Washington, DC 20426

Re: FirstLight Hydro Generating Company, FERC Project Nos. 2485-063 and 1889-081
Dye Test Information as requested as part of U.S. Fish and Wildlife Service Notice of Study Dispute

Dear Secretary Bose:

On April 8, 2014, FirstLight Hydro Generating Company (FirstLight), licensee of the Turners Falls Hydroelectric Project and Northfield Mountain Pumped Storage Project, attended a Study Dispute Meeting between the Federal Energy Regulatory Commission (FERC, Commission) and the U.S. Fish and Wildlife Service (USFWS). The study dispute pertains to USFWS requesting a study to quantify the level of entrainment of early life stage of American shad during the first year of studies.

At the meeting, the Study Dispute Panel asked whether pump samples could be safely collected from the Northfield intake tunnel service port. FirstLight addressed the question and noted that a dye test was conducted years ago to determine the approximate time to achieve steady state concentration after the start of dye injection. Enclosed is a section of a report which may be relevant to the Study Dispute Panel's inquiry. It was completed by Alden Research Laboratory in 1990 and explains the time to reach steady state concentration.

If you have any questions, or need additional information, please feel free to contact me.

Sincerely,

John Howard
FERC- Director Hydro Compliance

Enclosed: Appendix C of Alden Research Laboratory Report (1990)

Appendix C

Analysis of Dye Dispersion into Branches

The branches in the tailrace tunnel created areas of dead water into which dye dispersed slowly, causing a dye loss relative to the flow to be measured. Dye loss decreases the measured dye concentration thus appearing to increase the flow flow being measured. The rate of dye dispersion is a function of time, i.e. given sufficient time, the dead water zones would fill with dye.

In order to estimate an approximate magnitude of the error and the minimum time required to achieve an acceptable error, a series of laboratory tests were conducted. These reduced scale tests were scaled up to predict prototype behavior.

To obtain experimental data on which to base analytical predictions, a simplified physical model was constructed of 4" PVC pipe simulating a long penstock with a dead end branch of equal diameter. The branch could be isolated with a ball valve so that comparison tests could be conducted with and without the branch. A dye injection port was located about 140 diameters upstream of the branch and a sampling port was located about 120 diameters downstream of the branch. The upstream length was chosen to assure injected dye would be fully mixed prior to reaching the branch. The downstream length was chosen so that the flow would be homogenous at the sampling location after any local change in concentration at the branch. Dye injection and sampling were with the same equipment and methods as used in the field tests. Flow was provided from a head pond through a large diameter penstock such that the head on the system was constant and, therefore, the flow would be constant versus time. Flow was controlled by a downstream valve and a 4" by 2" venturi flow meter monitored flow rate.

Two type of tests were conducted: 1) dye was injected into the flow upstream of the branch and the effect of the branch on mixed concentration was measured and 2) the closed branch was filled with dye at a known concentration and the concentration in the main flow monitored versus time after the isolation valve was opened. Expected changes of dye concentration due to the branch were small, making accurate measurements with the first type of tests difficult due to inherent short term variations of output of the fluorometer requiring long term averaging to achieve high precision test results. The second type of tests, which is simply the inverse of type 1 tests wherein dye was dispersed from the branch rather than into the branch, allowed high initial dye concentrations to be used in the branch such that small rates of dispersion could be measured more accurately.

The results of the type 1 tests are summarized in Figure C1, which plots the deviation of each concentration measurement from the concentration averaged over all measurements versus time. The test procedure was to have the branch closed with the ball valve, inject dye into the flow 120 diameters upstream of the branch, and allow the mixed concentration to reach equilibrium, about 10 minutes total time. The branch isolation valve was then opened for 10 to 29 minutes to evaluate the effect of the branch on the measured concentration. The valve was then closed and concentration data were recorded for a short time without dye dispersion into the branch. Each concentration data point was averaged over about forty seconds and the average stored using the computer data acquisition system. Figure C1 plots the average data with a linear, least squares curve through all the data shown as a solid line. A separate linear regression curve, using only the data when the valve was open, is shown as a dashed line. Average flow velocities were 7.4, 4.5 and 2.7 feet per second for tests 2, 4 and 5, respectively. When the branch is open, the measured concentration would be expected to decrease, with the maximum change occurring immediately after the opening of the branch when the concentration gradients were greatest. In two cases, tests 2 and 4, a decrease of less than 0.5 percent occurred with time. However, Test 4 showed a substantial increase while the branch was open. Additionally, the trend of concentration for tests 2 and 5 was to decrease with time over the entire test period, even when the branch was closed. The maximum effect of the branch occurs immediately after the valve opens when the gradient of dye is at its maximum, but due to the size of the experiment, the time during which this occurs is relatively short and apparently could not be resolved. The fluorometer output for a constant concentration has substantial short term scatter, about 1 percent, about the mean line. To decrease precision uncertainties to less than 0.5 percent requires a relatively long time average, several forty second averages. The effect of the branch on average concentration is probably masked by this scatter, therefore, these data can not be considered conclusive in determining the effect of a dead end branch on concentration.

The second series of experiments were conducted with the branch filled with dye at a high concentration, such that small rates of dispersion of dye from the branch could be more easily resolved. The branch was filled with dye at a concentration of 40,000 ppb and the flow in the main line set to a constant value. The fluorometer output was recorded versus time, and the time the branch valve was opened was noted.

Figures 2 through 6 plot concentration, as a percent of the initial branch concentration, versus time measured at the end of the model penstock. Typically, the maximum measured concentration was less than 0.05% for the first full measurement period, i.e. one 40 second average. The response of the fluorometer is not sufficiently rapid to record the short term maximum concentration immediately after the branch valve was opened. For tests 2, 4 and 5, a 50% decrease from the maximum measured concentration occured in 2 to 3 minutes. Tests 1 and 3 show a lesser decrease, but initial measurements in these cases may be displaced slightly in time resulting in a lower initial reading. The rate of change decreases after a few minutes to a substantially lower value. Maximum measured concentrations are very low, sufficiently small to be essentially neglected in the flow calculation, even when two branches occur in series as was the case in the prototype. In the model, after about 1 minute the concentration was less than 0.05% for one branch, or 0.1% for two branches. After five minutes the error due to the dispersion of dye into three branches would be less than about 0.05%.

To scale the test results to the prototype, the velocity and geometric scales are used. The pertinent mixing phenomena are a function of the Euler number. Form loss coefficients, therefore head losses, mixing, and flow patterns are independent of size given a minimum Reynolds number. The model was sized to assure the minimum Reynolds number criterion was met such that flow patterns, and therefore mixing, are independent of length scale. The velocity ratio was calculated to be 1 to 3 based on a prototype velocity of about 15 feet per second (17 ft diameter and a flow of 3500 cubic feet per second) and a 5 foot per second model velocity. The length scale ratio is 1 to 51, therefore, the time scale (length scale divided by velocity scale) is about 1 to 17. One minute in the model thus equals about 17 minutes in the prototype. Therefore, to achieve an uncertainty due to dye loss into the two branches of about 0.10% requires a 17 minute operation in the prototype.

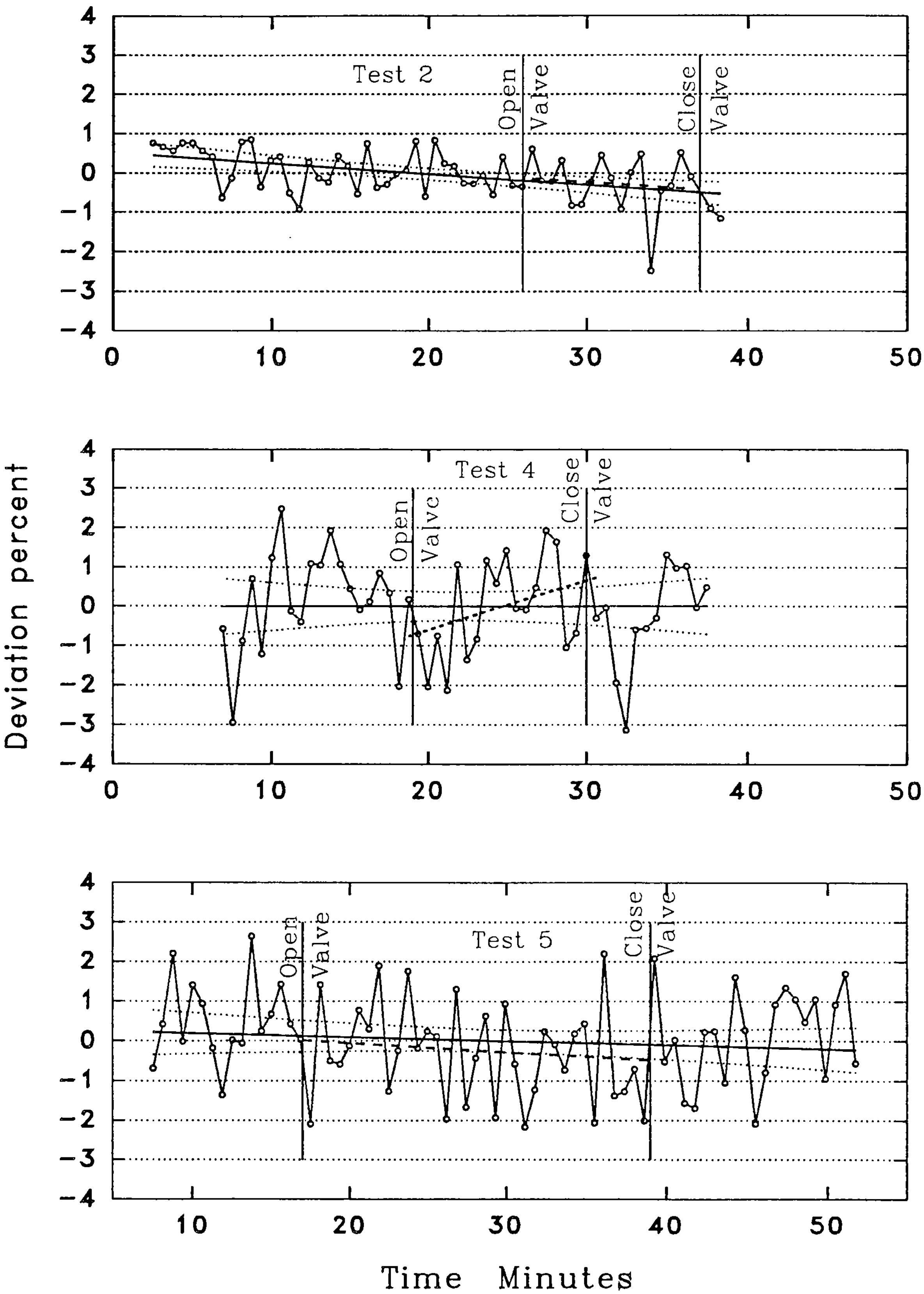

Figure C1 Deviation of Concentration from Average With Branch Opened

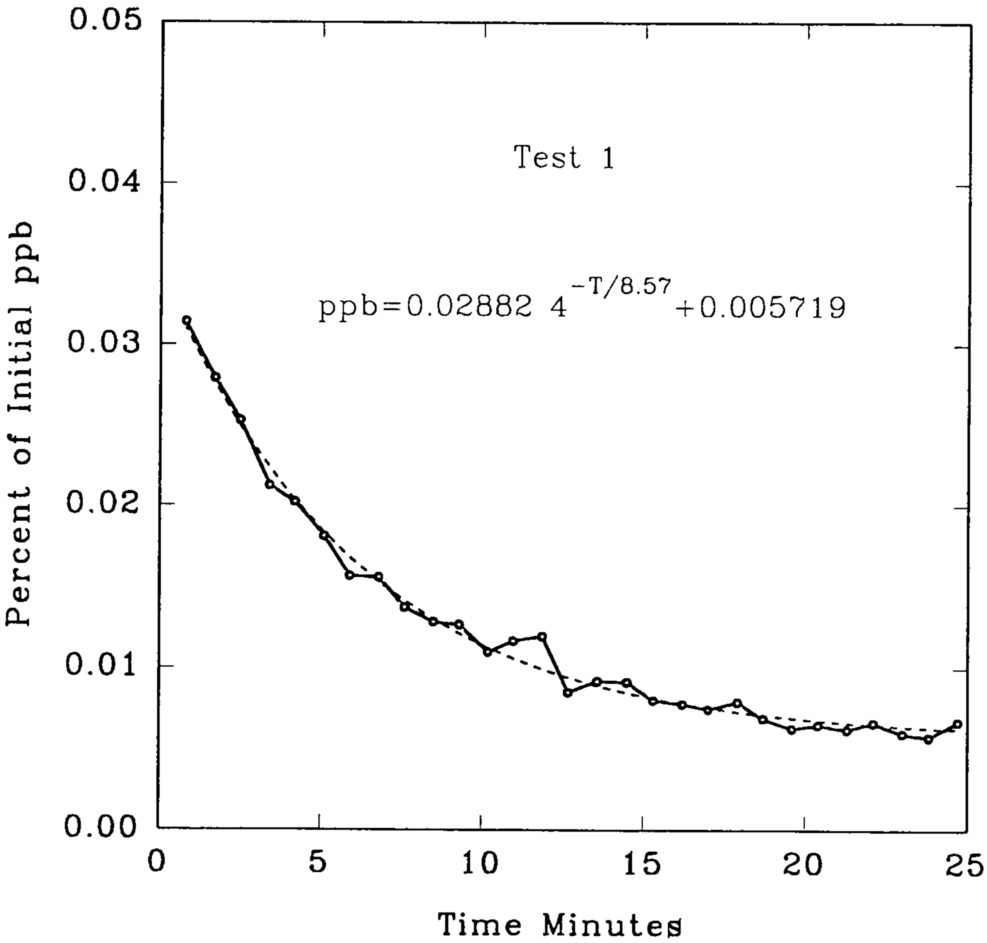

Figure C2 Concentration of Dye Dispered From Branch Versus Time

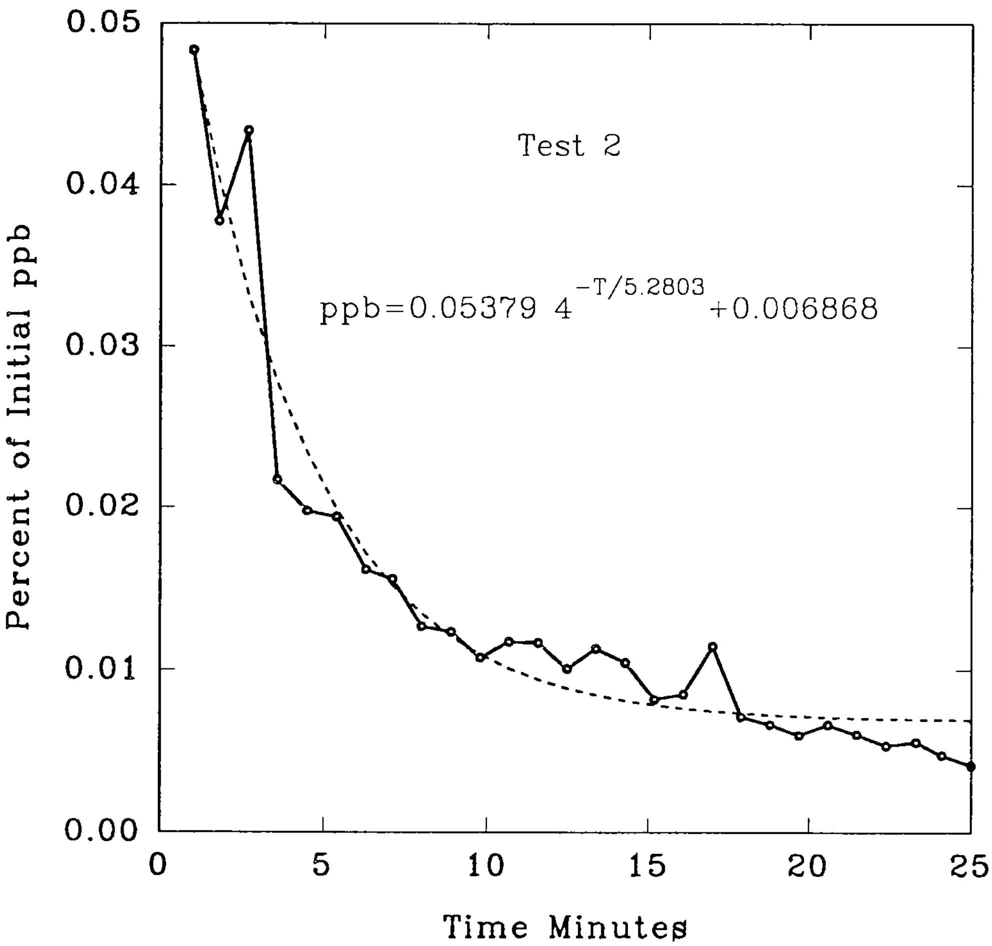

Figure C3 Concentration of Dye Dispersed From Branch Versus Time

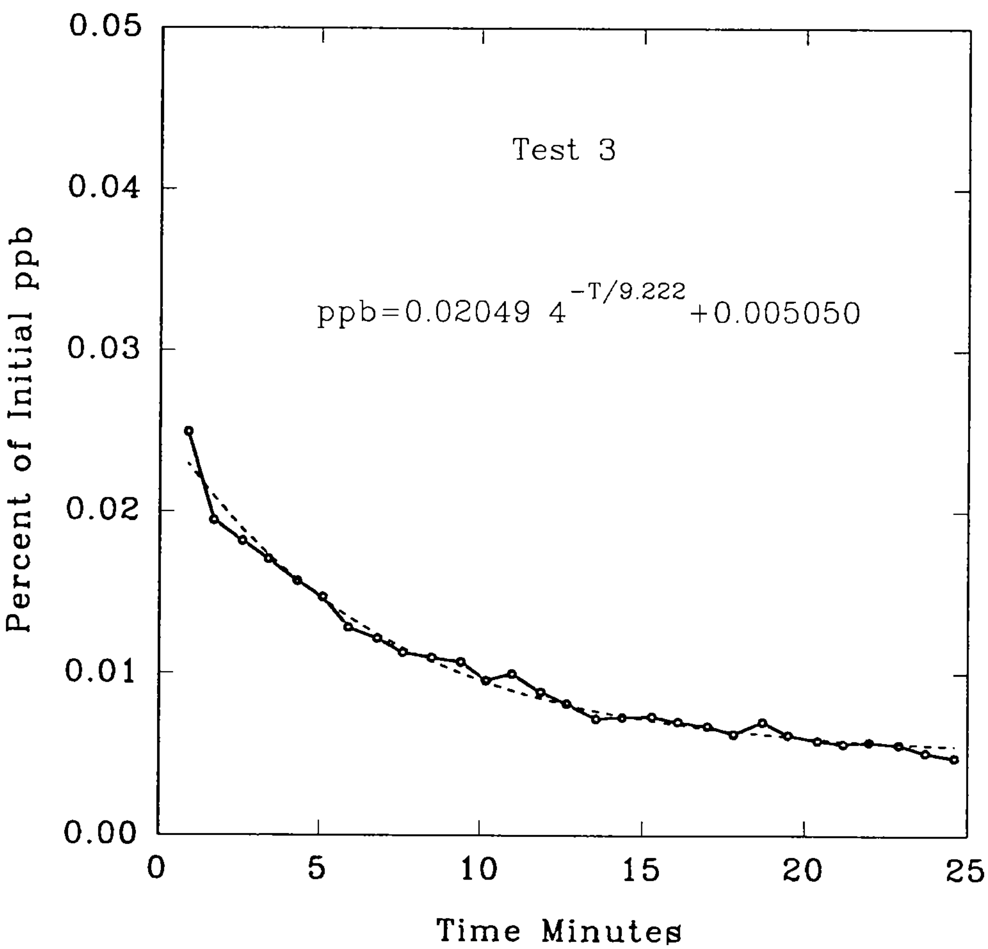

Figure C4 Concentration of Dye Dispersed From Branch Versus Time

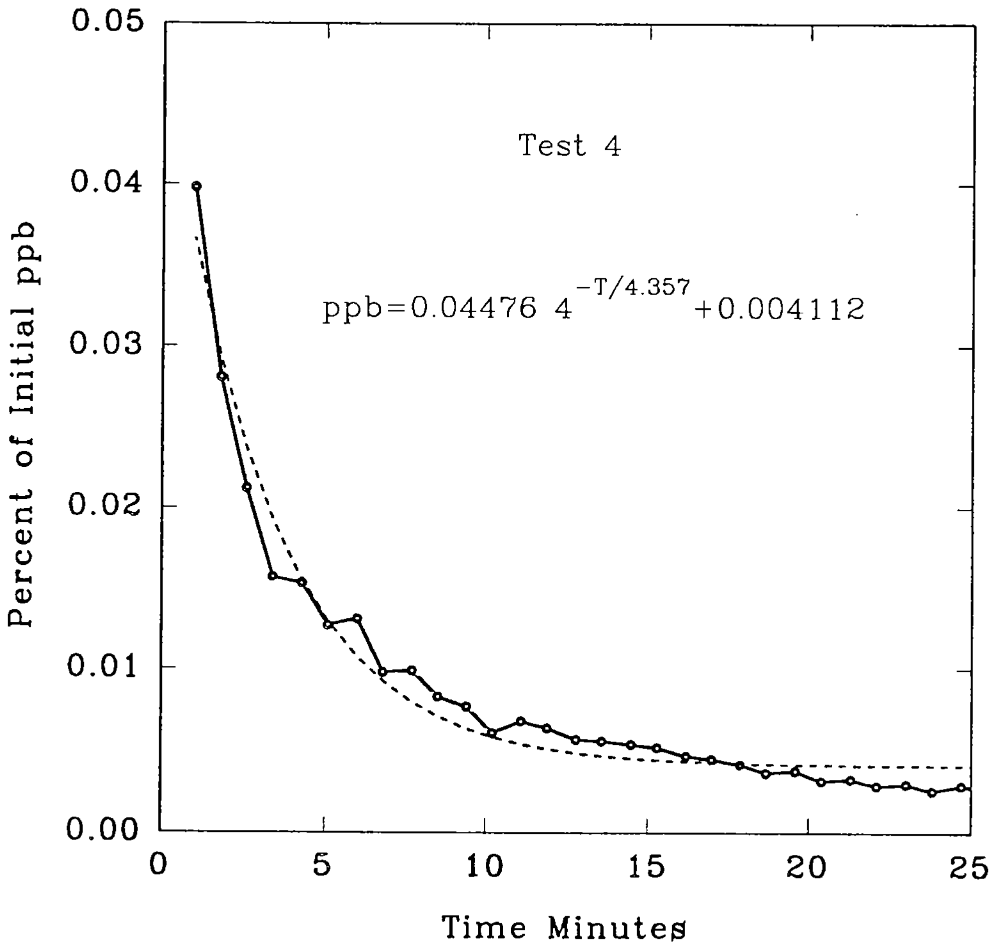

Figure C5 Concentration of Dye Dispersed From Branch Versus Time

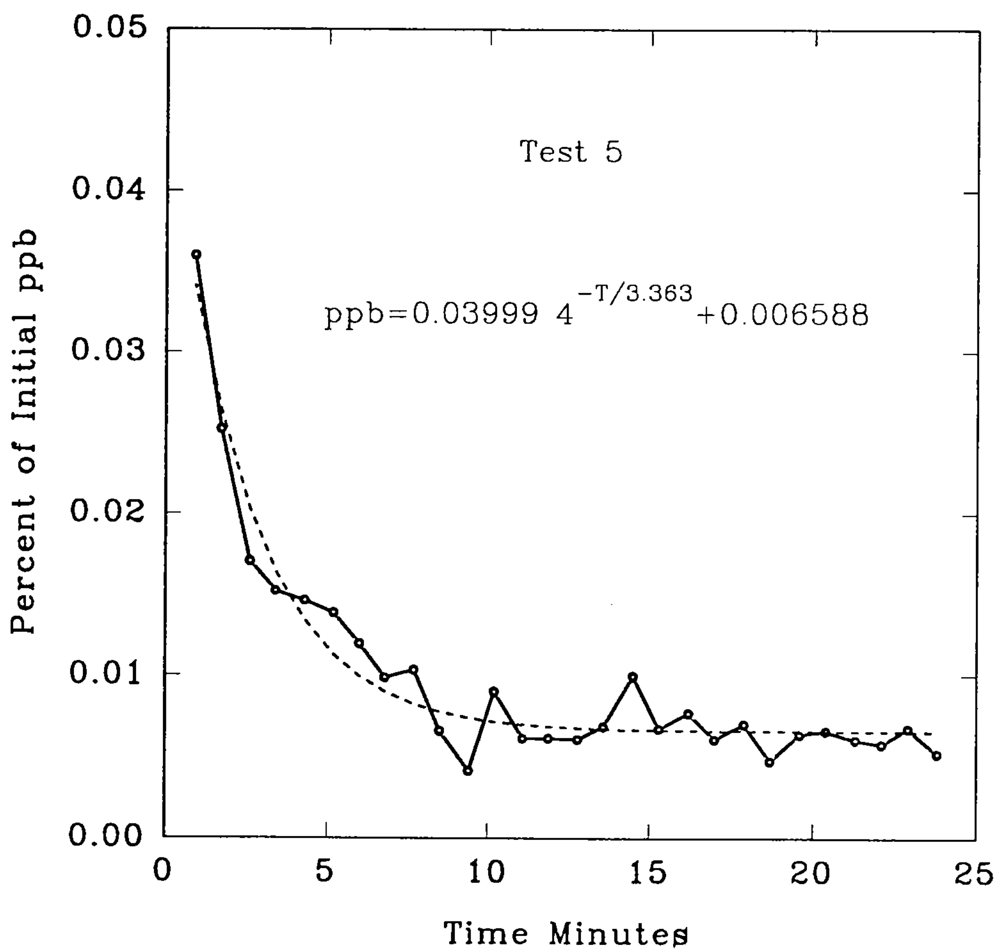

Figure C6 Concentration of Dye Dispersed From Branch Versus Time

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