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MEMORANDUM REPORT ARBRL-MR-03265

A MODIFICATION TO A FLASHLAMP-PUMPED DYE LASER TO INCREASE STABILITY OF THE SPATIAL MODE

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) meg

It was determined by Fitzpatrick and Piepmeier that the spatial mode structure of the beam from a CMX-4 dye laser (Chromatix, Sunnyvale, CA) could be stabilized by maintaining a precise relationship between dye loop and cooling water loop temperatures. A passive modification to the laser is described that eliminates the active heating and cooling mechanisms that were employed by the initial investigators to accomplish this.

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I. INTRODUCTION

The CMX-4 dye laser is a linear flashlamp-pumped device that excites the active medium (organic dye solution) with the light emitted from the flashlamp. The linear flashlamp and dye flow tube are at opposite foci of an ellipsoidal reflector. The flashlamp is cooled by being immersed in flowing deionized water. The deionized water is cooled through a heat exchanger by tap water. The water leaving the heat exchanger goes on to a second heat exchanger to cool the dye solution. The deionized water is circulated in a closed loop and is repurified continuously by a booster cartridge. It was found that maintaining tap water temperature at 30°C caused the total laser power, on a pulse to pulse basis, to be far more uniform. In addition, further improvements in the spatial mode structure, that is, how the power is distributed throughout the area of the beam, were attained by the aforementioned authors by maintaining the deionized water temperature from 0.5° cooler to 2.0°C warmer than the temperature of the dye solution loop. The original technique provides precision temperature-controlled cooling/reheating systems, one for each loop, which at best, is expensive, and increases the complexity of the overall system unnecessarily.

II. EXPERIMENTAL/RESULTS

Referring to the figure, the original piping of tap water and deionized water is shown on the left. Internal piping is cut where marked with an "X" and is reconnected as shown in the drawing on the right. The result of this modification is the reuse of the deionized water which has been used to cool the flashlamp to heat or cool the dye as necessary. Since the heat load on the dye is almost zero, the dye temperature quickly matches the temperature of the deionized water to within the desired range, as indicated by the results in the table. No active temperature control units are required to maintain the desired temperature relationship.

III. CONCLUSION

The technique described rather elegantly eliminates unnecessary temperature control mechanisms (accomplishes the desired goal with no expense whatsoever for additional apparatus), and achieves the goals of increased spatial mode structure stability as described by FitzPatrick and Piepmeier.[1]

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[1] *J.R. FitzPatrick and E.H. Piepmeier, "Thermal Effects Upon Spatial Mode Structure of a Linear Flashlamp-Pumped Dye Laser," Anal. Chem., Vol. 50, No. 13, p. 1936, 1978.*

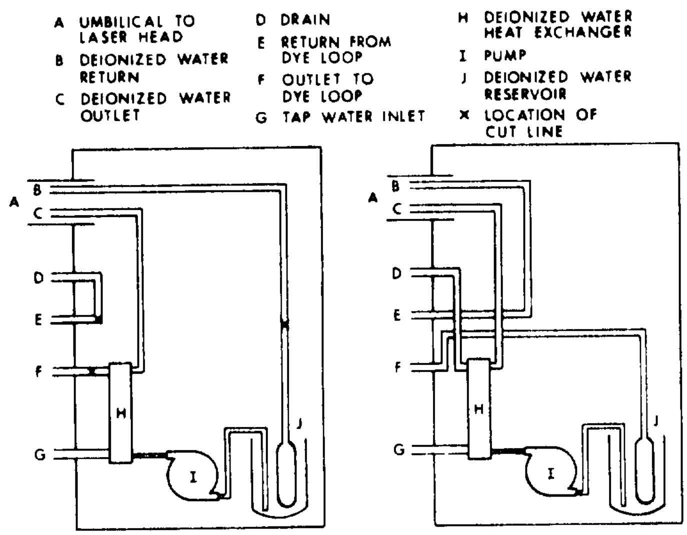

FIG. 1. Left, block diagram of unmodified CMX-4 coolant syystem; right, block diagram of modified CMX-4 coolant system.

Temperature measurements were made after the CMX-4 was stabilized at 10 pulses per second with the following results:

TABLE 1. TEMPERATURE, °C

Room	Tap Water	Deionized Water, $T_{(1)}$	Dye, $T_{(2)}$	$T_{(2)}-T_{(1)}$
23.2	20.3	25.4	26.0	0.6
24.7	25.8	29.4	30.3	0.9
23.4	30.0	32.1	32.3	0.2

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