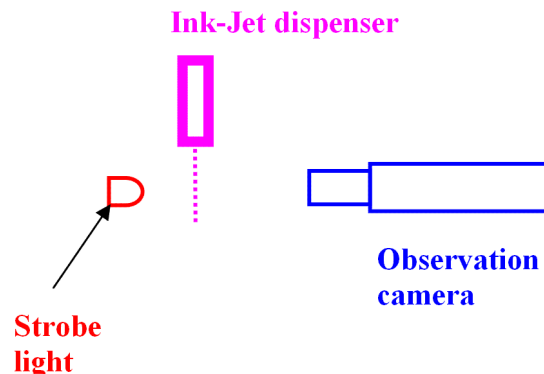


Observation Camera

Observation Camera

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During drop formation it is useful to observe the drops being generated to get an idea of the drop characteristics (diameter, velocity and directionality) and for troubleshooting (identification of clogging or air bubble presence). High speed cameras could be used for this purpose, but they are expensive and require special illumination. Drop observation can be achieved in a more cost effective manner using synchronized illumination.



A light emitting diode (LED) is located on the opposite side of the camera with the dispenser in between (see figure to the right). The LED is lit by a pulse synchronized (same frequency) with the drop generation. An adjustable delay between the actuation pulse for the drop generation and the LED pulse “freezes” the drop along its path for observation. The drop generation sequence has a collection of images that were obtained during drop formation at increasing delay time between the actuating signal and the LED pulse.

This set-up allows the visualization of the drop as it is ejected from the orifice. Observation with this camera allows the operator to evaluate the drop ejection and to measure the drop characteristics (diameter or velocity). This measurement can be made in an automated fashion if image capture and analysis software is used in conjunction with the horizontal camera.

Stroboscopic illumination does not look at an individual drop, but at a collection of droplets that overlay in the camera view. If single drop characteristics are necessary, a high speed camera is required. When setting up an observation system as described above, the magnification of the optics has to be such that the drops (average size around 50 μ m in diameter) are sufficiently large on the video display or the computer monitor.

The length of the pulse that turns on the LED has to be fairly short (preferred around 5 μ s and no larger than 10 μ s) to prevent “smearing” of the drop along the trajectory. The LED has to be selected to produce sufficient light for drop observation; this becomes critical at low operating frequencies. At high drop generation frequencies, there is generally too much light and this causes the drops to be “washed out”. A means of reducing the amount of light has to be provided by either reducing the length of the pulse going to the LED and/or not sending the pulse to the LED for every drop being generated. MicroFab provides both the camera and the associated optical elements. The JetDrive™ has a built-in output for the LED with the delay being controlled in the software and directly through a knob on the box. JetDrive™ comes with all the associated cables and the LED. Other related equipment includes a video capture board and an image analysis program that allow automatic measurement of the drop parameters.