Q.A. Collectible

Sponsored by CRCPD's Committee on Quality Assurance
in Diagnostic X-Ray (H-7)

Maintaining Film Processing Quality in Low Volume Processors

How should a low volume processor be maintained to provide consistent film quality? What criteria determine if a processor is low volume? A typical example is the clinic that may do chest films only on about 5 – 10 patients per day. Other low volume factors are atypical film densities and/or single emulsion films.

Standard developer solutions today are designed to be used in a normal volume-processing situation of about 50 - 14 x 17-inch double emulsion films per day. If the volume is lower, the developer solution does not operate the way the manufacturer intended. There is an important chemical interaction between the films being processed and the developer solution that does not balance out properly when the volume falls below designed levels.

As film is processed, the exposed silver bromide crystals in the film emulsion are converted to free silver and a bromide ion. The free silver remains in the emulsion and the bromide is released to the developer. Processors and developer chemistry are designed with the assumption that a certain amount of bromide will exist in the chemistry from previously processed film. The bromide is utilized as a fog suppressant to prevent unexposed silver bromide crystals from being developed.

Since fresh developer has little bromide (bromide from film processing being anticipated), a fresh tank of developer may be much more active than seasoned developer, and initial films may be considerably darker than subsequent films. To counteract this effect, a "starter" solution is added to the developer in the processor tank (but not to developer in the replenishment tank). The starter solution contains bromide that chemically alters the first processor tankful of developer solution to imitate developer solution that has been in use for a few days or has had several hundred films processed through it. As films are developed and the developer solution in the tank is used up, fresh developer (without bromide) from the replenishment tank is pumped in to replace the volume. A delicate chemical balance is thus maintained.

In discussing low-volume processing considerations, let us start with a properly operating processor, properly mixed solutions with starter added to the developer in the processor tank, appropriate temperatures, and typical replenishment rates set for normal processing volumes.

The first films through should be properly developed. If the volume of film processed is lower than recommended for “normal” conditions, the developer in the processor tank has a chance to oxidize and lose strength. Additionally, the developer level in the processor tank may drop several inches due to evaporation, resulting in a decreased immersion time. Subsequent films are then underdeveloped. The typical response is to increase patient exposure to compensate for the underdeveloped films. A different response, with the same effect, is to increase the replenishment

Conference of Radiation Control Program Directors, Inc. (CRCPD)
205 Capital Avenue
Frankfort, KY 40601
www.crcpd.org

April, 1991

rate in the processor. Low-volume processors may then overdevelop the film, since the replenished chemistry in the tank is more active and does not contain sufficient bromide to protect against fogging. As time goes on, the developer in the replenishment tank becomes oxidized, loses strength, and films are again underdeveloped, calling again for either an increased patient exposure or increased replenishment rate.

There are several methods of compensating for low volume and keeping the development process stable.

One method is called Flood Replenishment. It was developed by Donald E. Titus of Eastman Kodak Company.[1] Normally, processors have a replenishment sensor that controls replenishment rates on the basis of number of inches (length) or square inches (area) of film fed into the processor. With Flood Replenishment, the sensor is replaced by an interval timer that initiates replenishment at intervals, independent of the number of films being processed. The system is adjusted so the solution in the processor developer tank is replaced every two days. Using this method, developer solution in the processor does not have a chance to oxidize prematurely. Also, starter solution is added to the developer in the replenishment tank to provide a more consistent chemical concentration and balance. By adding starter solution to the developer in the replenishment tank, it is not necessary to add additional starter to the developer in the processor when the chemistry is replaced every two days. While Flood Replenishment does an admirable job of keeping processing stable, it does use more developer chemistry than normal. The trade-off, however, may be well worth the additional cost. Details on Flood Replenishment may be obtained from processor manufacturer representatives.

A second option, an alternative to Flood Replenishment, may be considered for mild processing problems. Sixteen ounces of starter solution (one bottle) is added per five gallons of developer in the replenishment tank. This chemistry mix is used to fill the developer tank. Additional starter is not added to the developer tank and the replenishment rate is increased to 100 ml per 14 x 17-inch film. This option does not require the changing of the sensor system and uses less chemistry than Flood Replenishment.

1. Titus, D.E., Flood Replenishment for Dedicated or Low Volume KODAK RP X-OMAT Processors (Kodak Publication MPA 7.235). Eastman Kodak Company, November 1979.