# SmartRinse — Maximizing throughput

## Technical Overview

### 700 Series ICP-OES

**Introduction**

SmartRinse speeds up sample wash-out, reducing carry-over and increasing productivity. SmartRinse is a feature in the ICP Expert II software, which optimizes the rinse time between samples. Rinse times for ICP-OES depend on a number of factors, such as the length and material of tubings, the sample introduction components used, and the nature and concentration of the elements being measured. Typically, low concentrations of an element in a sample will take less time to wash out to a negligible level than higher concentrations (Figure 1). For this reason, rinse times are often set high to account for a worse-case scenario accepting the fact that for some samples, the amount of rinsing will be unnecessary and unproductive. SmartRinse monitors the wash-out of selected elements during the rinse phase until element signals meet a pre-determined (user-specified) threshold. In this way, SmartRinse ensures the optimum rinse time is achieved for each sample.

## How does SmartRinse work?

SmartRinse begins by measuring the baseline signal of selected element emission lines at the start of an analysis. This is done by measuring 10 x 0.5 second replicates of the rinse solution. The threshold intensity for each line is then calculated using the following equation:

$Threshold_B = I_B + (n_B \times SD_B)$,

where:

$Threshold_B$ = threshold intensity of emission line B
$I_B$ = average of 10 intensity measurements made at wavelength B
$n_B$ = user-selectable SD factor for emission line B
$SD_B$ = standard deviation of 10 intensity measurements made on emission line B

| Rinse no. | Rinse time (s) | | |
|---|---|---|---|
| | Mn 2 mg/L | Ca 1000 mg/L | Mn 2 mg/L + Ca 1000 mg/L |
| 1 | 7.9 | 37.1 | 46.0 |
| 2 | 6.7 | 42.7 | 45.0 |
| 3 | 6.8 | 47.1 | 45.0 |
| 4 | 6.8 | 39.3 | 50.5 |
| 5 | 5.6 | 41.6 | 47.3 |
| 6 | 5.6 | 52.8 | 48.3 |
| Average | 7 ± 1 | 42 ± 6 | 47 ± 2 |

**Table 1.** SmartRinse stops rinsing after all selected elements have met their thresholds. Shown here are the results of six rinsing trials for: Mn 257.610 and Ca 396.847 individually and collectively, and the effect of concentration on rinse time. SD Factor setting for both wavelengths: 70.

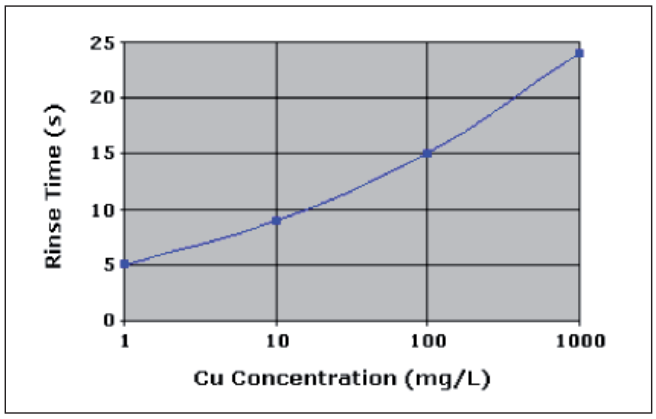


**Figure 1.** SmartRinse adjusts the rinse time according to element concentration. Shown here is the SmartRinse time required to meet the threshold value for different element concentrations.

After a sample has been analyzed and the rinse phase has begun, SmartRinse continuously measures the signal intensity of the nominated lines every 0.5 second, and compares this to the threshold intensity. If all the measured intensities fall below the threshold values for each line, rinsing will stop (Table 1).

It is assumed that the specified maximum rinse time is sufficient to completely wash out the previous sample from the sample introduction system. During SmartRinse, if the threshold point is not achieved and the maximum rinse time is reached, it is assumed the limit was not reached due to contamination of the rinse solution. In this case the measurements taken at the end of the rinse phase are used to recalculate the thresholds for only the affected emission lines (those lines not going below the baseline threshold). This assumption avoids the situation where the maximum rinse time occurs after each solution due to contamination of the rinse solution. SmartRinse is available when using the Agilent SPS 3, CETAC ASX500 series and AIM1250 autosamplers.

## Adjusting the sensitivity of SmartRinse

The sensitivity of SmartRinse and thus the degree of rinsing required can be set by adjusting the SD factor for each element. A small SD factor will produce a low threshold. Therefore, during the rinse stage following the analysis of a sample, the analyte signal will need to drop below the threshold point before the rinse cycle will end and the autosampler prepares to present the next sample.

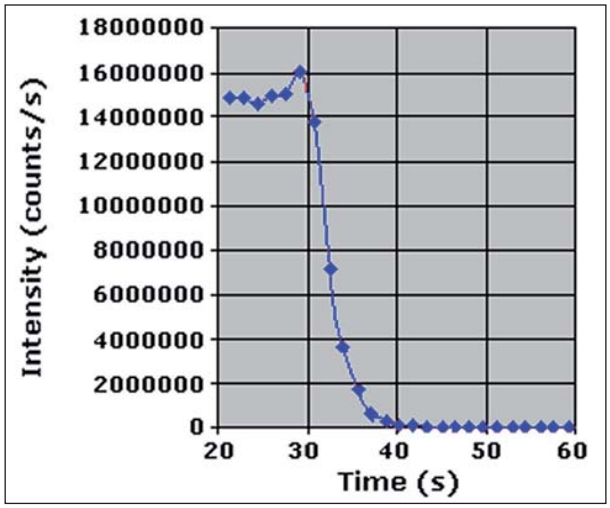


**Figure 2.** Timescan of 1000 mg/L manganese washout profile. Emission line monitored: Mn 257.610. Washout was achieved in 40 ± 6 s. Washout time defined as from the time rinsing begins to when four orders of magnitude decrease in original signal is achieved.

For example, if during the initial determination of the threshold intensity for Mn 257.610 nm averaged 1000 counts with a standard deviation of 10 counts, then an SD factor of 5 would give a threshold intensity of 1050 counts (1000+(5x10)). On the other hand, an SD factor of 100 would produce a threshold intensity of 1500 (1000+(5x100)) and would require a shorter rinse time to wash out Mn from the sample introduction to this level.

There may be occasions where the wash-out of an element is of particular concern, because especially high concentrations are expected. In these instances, the SD factor in the ICP Expert II software can easily be changed. For example, if it was required to obtain a minimum wash-out of four orders of magnitude for manganese, a timescan can be performed to obtain a wash-out profile of a 1000 mg/L solution of manganese (Figure 2).

The time required to obtain a decrease in signal intensity of four orders of magnitude is then easily calculated. The average rinse time required to obtain four orders of magnitude wash-out for manganese was found to be approximately 40 s with the Agilent 720, which included a single-pass glass cyclonic spraychamber and a glass concentric nebulizer. It was then determined that a wash-out of four orders of magnitude for manganese was achieved with an SD factor of 70 (Figure 3).

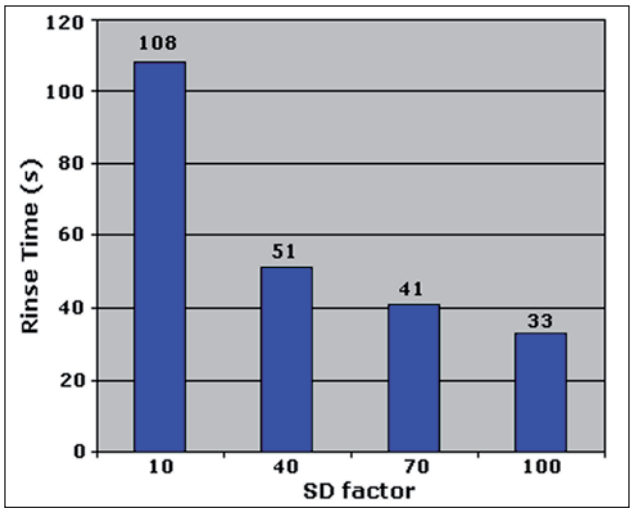


**Figure 3.** An SD factor setting of 70 provides a washout of four orders of magnitude for manganese. Emission line monitored: Mn 257.610.

## Conclusion

SmartRinse is a powerful, easy to use software feature that optimizes the wash-out time of every sample, ensuring accurate results and increasing productivity. The sensitivity of SmartRinse can also be adjusted for specific applications.

## For more information

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