Bath Life Determination

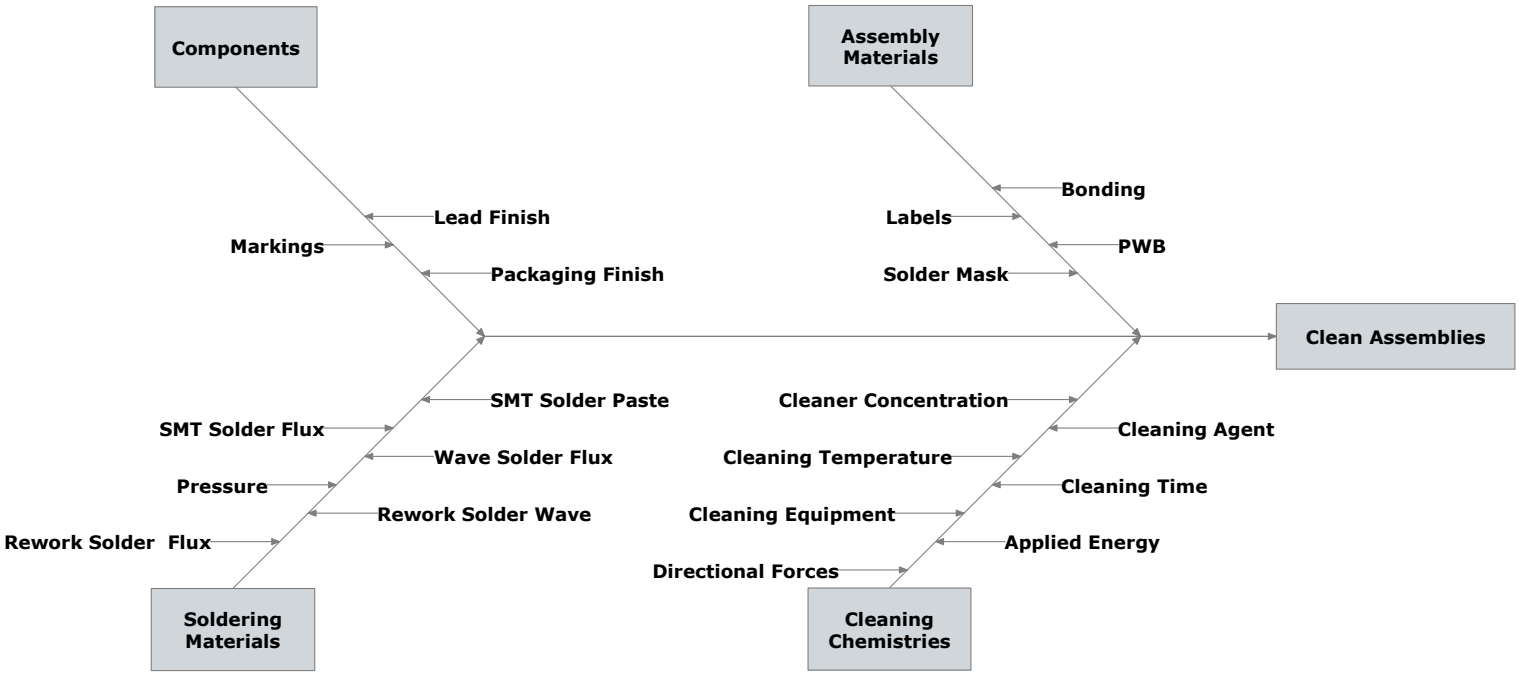
Background Information

The bath life of electronic cleaning wash chemistries is a function of the probability that the wash bath will perform its intended function during a specified period of time under stated conditions. Wash bath determination is concerned with meeting the probability of success, at a specific confidence level. Bath life is predicated on the intended function of dissolving customer specific flux residues at a specific rate without failure. Reliability is measured at a specific period of time during which the cleaning system has a specified chance that it will operate without failure. Product performance is a function of flux (soil) loading at a specific wash bath concentration range and temperature.

Wash Bath Dynamics

Electronic cleaning materials are designed to remove specific flux types in specific cleaning machine designs. The cleaning chemistry must be matched to the soil and cleaning machine. Electronic cleaning materials operate at a specific working concentration, temperature, time, and mechanical energy levels. Cleaning processes must take into account factors and levels that influence the wash process (Figure 1). The complexity of wash bath life probability increases as the number of cleaning process factors and levels vary.

Figure 1: Factors Influencing the Wash Cleaning Process

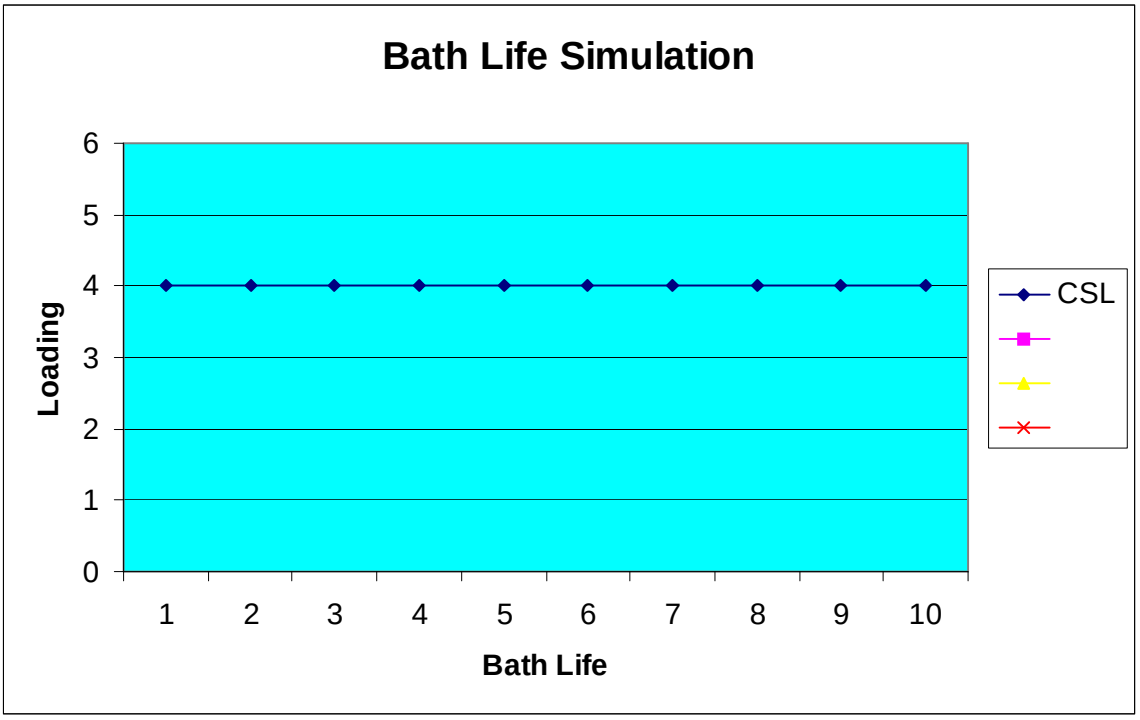


Critical Soil Loading Level

Critical soil loading is a function of the flux type and level that can be suspended in wash bath (Figure 2). Factors that influence soil loading:

1. Soil Type: Flux compositions are built with resin/rosins, activators, rheological additives, and solvent mixtures. High solids flux compositions will reach critical soil loading at a faster rate.
2. Wash Concentration: Cleaning materials are built with solvents (dissolution), reactivity (saponification), wetting (surface tension), and minor ingredients (foam control and inhibition). Aqueous cleaning fluids designed to operate at low concentrations will reach a critical soil loading level at a faster rate.
3. Wash Time: Soil build in the wash bath reduces available cleaning material driving forces and may require longer exposure time as a wash bath reaches the critical soil loading level.
4. Mechanical Energy: Mechanical energy improves cleaning rate by delivering the cleaning material to the soil at a faster rate. Mechanical energy may improve rate while running the process at lower cleaning chemistry concentration and time levels. At these lower levels, critical soil load may be reacted over a shorter time.
5. Other Factors: Cleaning materials are designed to break foam faster than foam build. Flux ingredients are natural foaming materials, and at higher levels in the wash bath, foam control will steadily decline. Foam generation from the mechanical energy will decrease cleaning effectiveness.

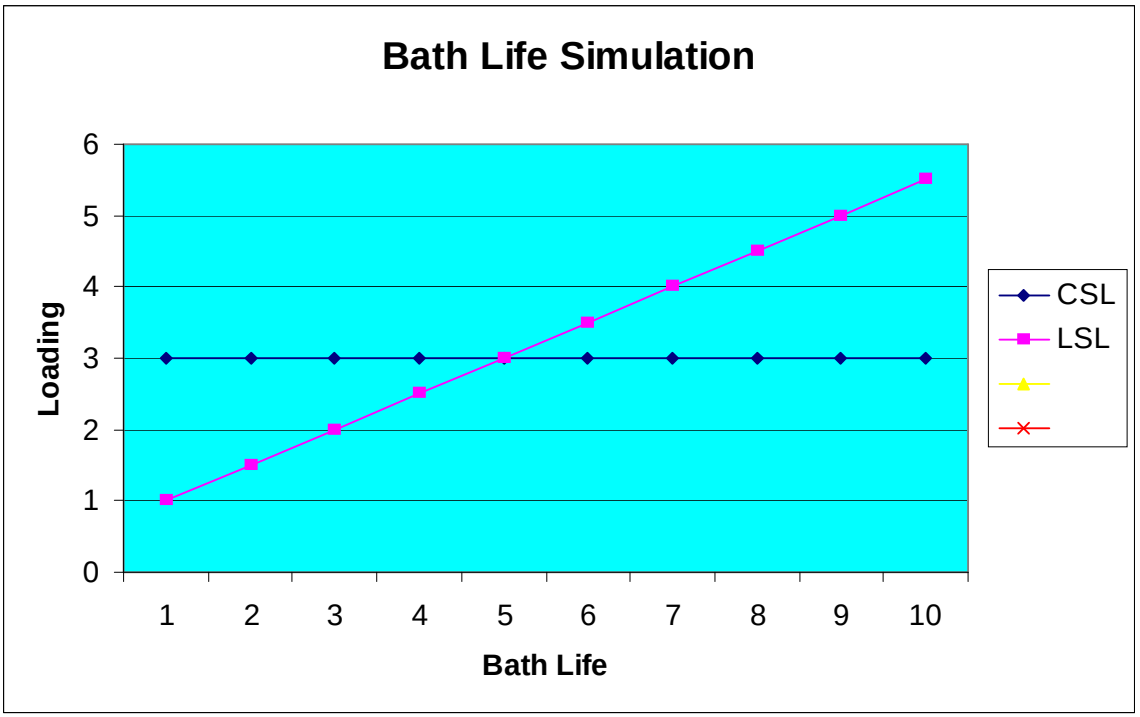
Figure 2: Critical Soil Loading



Linear Soil Loading

In the absence of losses in the form of wash exhaust evacuation and wash drag out, soil loading would build at a linear rate (Figure 3). If wash baths were controlled with no exhaust or drag out losses, wash bath life would be easily controlled as function of soil loading. Rarely do wash baths build soil at a linear rate, and as such, soil loading must factor in wash bath loss and replenishment.

Figure 3: Linear Wash Bath Soil Loading



Steady State Condition

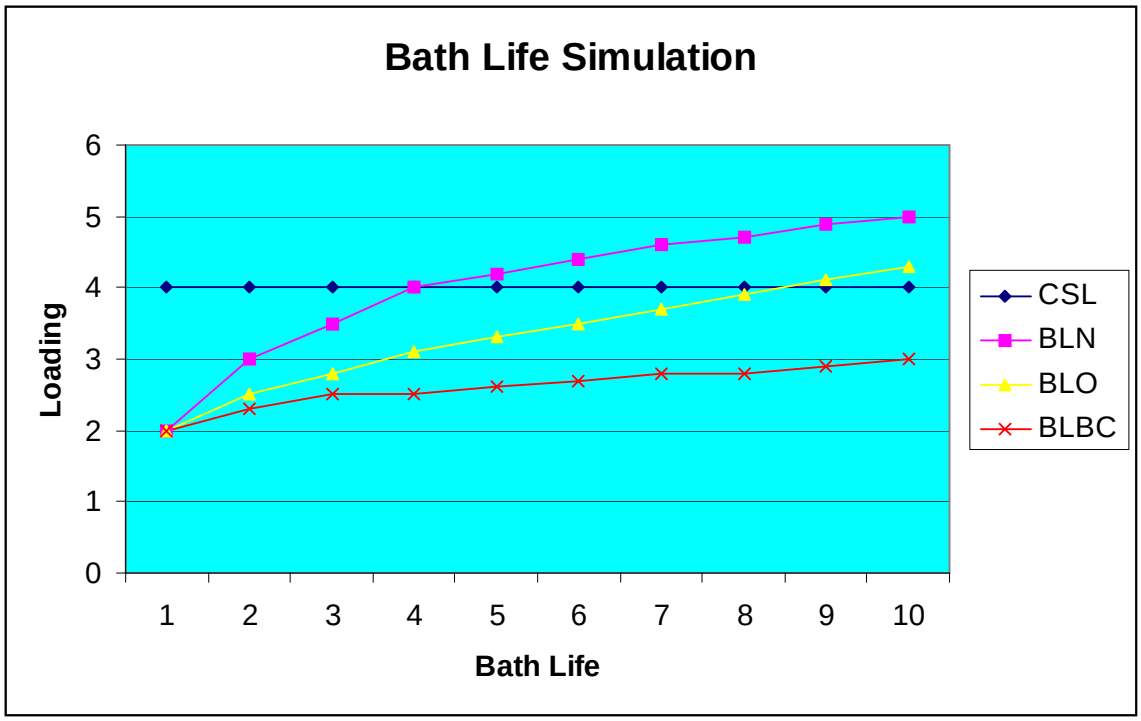
Electronic wash processes are rarely static but dynamic (Figure 4). During most wash processes, losses will occur through exhaust evacuation and drag-out from the wash to the rinse section. As losses occur, the wash tank calls for water and chemistry. Controlling the upper and lower chemistry limits reduce variability and increase the probably of bath life time. Important factors include wash concentration and critical soil level. As wash chemistry is lost from the system, some of the soil is also lost. As long as the losses of wash fluid and addition of new wash chemistry maintain the wash bath under the critical soil loading level, wash bath time is extended. Figure 4 illustrates three wash bath soil levels:

1.

Steady State Condition Cont.

1. BLN (Bath Life Normal) – The wash bath is tightly controlled with minimal loses from drag out and exhaust using a low wash chemistry concentration. At these levels, soil loading reaches critical soil loading at a faster rate.
2. BLO (Bath Life Optimal) – The wash bath is tightly controlled with minimal loses from drag out and exhaust using a higher wash chemistry concentration. At these levels, the addition of new chemistry to the wash extends time to reach critical soil loading.
3. BLBC (Bath Life Best Case) – The wash bath is tightly controlled with minimal loses from drag out and exhaust using a wash chemistry concentration that reaches a steady state condition so that the wash bath does not reach critical soil loading. As this wash bath concentration level, bath life is extended into weeks and months before time is reached.

Figure 4: Wash Bath Life Simulation



Recommended Wash Bath Change

Bath life change out needs to be matched to the process levels used for each specific cleaning process. Kyzen recommends the following frequencies (time) for changing out the wash bath to be correlated with the estimated time to reach the critical soil loading level:

1. Low wash chemistry concentration with high levels of parts being cleaned: This condition matches up with the BLN condition and the wash should be changed on a frequent basis. The most like time is days or weeks for change outs.

Recommended Wash Bath Change Cont.

1.Low wash chemistry concentration with high levels of parts being cleaned: This condition matches up with the BLN condition and the wash should be changed on a frequent basis. The most like time is days or weeks for change outs.
2.Medium wash chemistry concentration with high levels of parts being cleaned: This condition matches up with the BLO condition and the wash bath change out frequency should be thought of in weeks and possibly months.
3.High wash chemistry concentration with high levels of parts being cleaned: This condition matches up with the BLBC condition and the wash bath change out frequency should be thought of in months.

Due to the high variability of factors and levels involved within different wash processes, frequency (time) of the wash bath must be matched to these factors and levels to accurately define the process window.