



ATP, RLUs and CFUs

ATP can be used to monitor cleanliness.

Just because an environmental surface looks clean does not mean it is clean. Microorganisms, biofilm and other biological residues are not visible to the unaided eye thus rendering the current visual inspection method for cleaning monitoring inadequate to the task. Adenosine triphosphate (ATP), has been found to be a sensitive indicator molecule for the presence of biological residues due to its universal presence in all living cells (microbes, animal and plant cells). An increase in “dirt” (biological residues) on a surface results in an increase in the amount of ATP present on that surface making ATP an effective marker for the assessment of the hygienic status of an environmental surface.

ATP is indirectly measured using a bioluminescence assay.

Collecting ATP from a contaminated surface is as easy as swabbing with a 3M™ Clean-Trace™ ATP Surface Test. The amount of ATP present on the swab is a quantitative measurement of the cleanliness of the surface tested.

To determine the hygiene status of an environmental surface one must measure the amount of ATP present on the swab. Directly measuring the concentration of ATP on the swab requires extensive training, sophisticated equipment and time. It is therefore easier and faster to determine the amount of ATP on a swab indirectly. There are many different methods that are used for ATP determination, but the most successful technique is the bioluminescent method because of its sensitivity and wide dynamic range.¹

One can look to nature for examples of how various organisms like fish, bacteria, snails and fungi generate light through various bioluminescent processes. The system used in the 3M™ Clean-Trace™ Hygiene Management System is one of nature's most efficient and well-studied light-generating reactions, the ATP bioluminescence system found in *Photinus pyralis*, the firefly (Fig 1).²

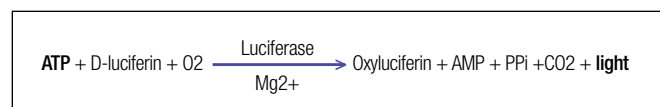
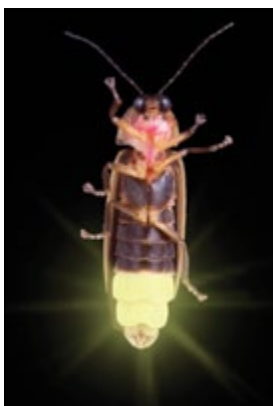


Figure 1

In the presence of the enzyme luciferase, the ATP collected on the Clean-Trace ATP Surface Test reacts with oxygen and the light-emitting pigment luciferin resulting in the emission of photons of green-yellow light.

Cleanliness is measured in RLUs.

The ATP collected on the swab is used to generate a light signal using the luciferin-luciferase system described above. Under optimum conditions the amount of ATP is directly proportional to the amount of light emitted.

The amount of light, as measured by the luminometer, is expressed in RLUs or Relative Light Units. Figure 2 illustrates the simple relationship that exists between the RLU value and the cleanliness of an environmental surface.

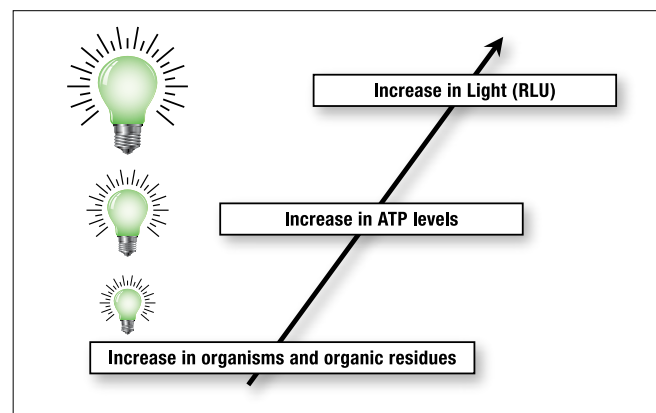


Figure 2

An RLU is not a standardized unit of measurement like inches or centimeters. Because different ATP monitoring systems have different outputs, sensitivities, reagent formulations and light detection systems the RLU scales are different for each system. Each manufacturer sets their own value for 1 light unit and all measurements are made relative to that value. Larger RLU values do not indicate that a system is more sensitive. Because each manufacturer uses a different scale one must be careful not to use RLU values to compare different ATP monitoring systems.

The relationship between RLUs and CFUs.

The number and types of bacteria present on a surface is of concern to any Infection Control practitioner and is normally assessed using various microbiological methods. Viable plate counts are used to assess the number of living bacteria present on a surface where the results are expressed in colony forming units (CFUs) per area of surface tested. The 3M™ Clean-Trace™ Hygiene Management System detects ATP from bacteria in addition to all other biological sources of ATP and therefore is not a measure of the numbers of bacteria (CFUs) but a measure of cleanliness (RLUs). Because CFU and RLU values are determined using different test methods and measure different substances one would not expect RLU values to consistently correlate to CFUs when testing an environmental surface. ATP hygiene monitoring provides a measurement of the direct risks resulting from high levels of microorganisms PLUS the indirect risks resulting from organic residues that can protect and provide a source of nutrients to microorganisms.

References

1. Kyriakides, AL and Patel, PD (1991). Rapid hygiene monitoring using ATP bioluminescence. *Bioluminescence and Chemiluminescence: Current Status*; 519–522. John Wiley and Sons, Chichester.
2. Gould SJ and Subramani S. (1988). Firefly luciferase as a tool in molecular and cell biology. *Anal. Biochem.* 175 (1): 5–13.

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