Adenosine Triphosphate (ATP) bioluminescence measurements.

Technology background and use.

Background on ATP Technology.

ATP bioluminescence assay cell detection was developed by NASA in the 1950s to help identify living cells (life) on other planets. It is now a technology used in both the food and healthcare industries to quantitatively validate surface cleaning methods[1].

What is ATP bioluminescence and how does it work?

+ ATP stands for adenosine triphosphate; it is the molecule used for energy storage in all types of living cells (animal, plant, bacteria, yeast, and mold)[1].
+ The ATP bioluminescence monitor device detects the amount of ATP present on a surface using the same biology that fireflies use to glow.
+ The insect has two chemical compounds, luciferin, and luciferase, that react with the firefly's ATP to produce bioluminescent light[1].
  - One ATP molecule produces one photon of light[2].
  - Photons of light, measured in relative light units (RLU), are detected by the monitor and are proportional to the amount of ATP present. Therefore the reading is an indirect measurement of organic residue on the surface[2].

What are the advantages of using ATP bioluminescence?

+ ATP testing is a simple, cost-effective, rapid method which provides real time quantitative results in a rapid healthcare and food industry environment. The intention of the testing is to validate the cleaning processes in place for surfaces and equipment[1].

What are the disadvantages of using ATP bioluminescence?

+ The bioluminescence detected and read as RLU may not entirely be due to viable bacteria-ATP bioluminescence will also be detected from dead bacteria - resulting in a false elevated reading[1].
  - Processing residues on equipment (blood and tissue) can also increase the RLU because luciferase reacts with eukaryotic and prokaryotic ATP[2].
+ Micro-organisms are not uniformly spread across environmental surfaces or medical devices and a low reading on one surface may not be indicative of a low reading across the entire surface and there is a lack of consistent standardization across device manufacturers regarding sampling area for ATP testing devices[3].

What are the disadvantages of using ATP bioluminescence? (continued)

+ Each ATP device manufacturer has its own brand specific and arbitrary RLU scale making it difficult to make RLU results comparisons across brands[3].
+ It has also been reported that ATP devices can detect low levels of ATP but lack reliability and precision in detecting ATP quantities when levels are low[3].
+ ATP bioluminescence monitoring devices may not be able to detect gram negative bacteria due to incomplete cell lysis[4].

What impact can the presence of sanitizers or disinfectants have on ATP reading accuracy?

+ The presence of detergents, sanitizers, and other chemicals can impact the ATP reading and have unique impacts of either enhancing or quenching ATP readings[1,5].

Summary

EPA registered surface disinfectant products provide efficacy kill claims on the product Master Label. Disinfectant products undergo rigorous testing using methodologies prescribed by the EPA to achieve kill claims. Additional validation of these kill claims using ATP technology do not need to be performed by the customer. In addition, ATP technologies vary in sensitivity and can be impacted by the residual presence of sanitizer/disinfectant chemistries and the genetic materials of both live and dead organisms and other organic cells leaving interpretation of results unclear.

[1]https://www.qualityassurancemag.com/article/aib1013-atp-bioluminescence-assay/, accessed January 18, 2022
[2]Green, Tracy A., Scott M. Russell, and Daniel L. Fletcher. "Effect of chemical sanitizing agents on ATP bioluminescence measurements." Journal of food protection 61.8 (1998): 1013-1017.
[3]Whiteley, Greg S., T. O. Glasbey, and Paul P. Fahey. "A suggested sampling algorithm for use with ATP testing in cleanliness measurement." Infection, Disease & Health 21.4 (2016): 169-175.
[4]Turner, Danielle E., et al. "Efficacy and limitations of an ATP-based monitoring system." Journal of the American Association for Laboratory Animal Science 49.2 (2010): 190-195.
[5]Omidbakhsh, Navid, Faraz Ahmadpour, and Nicole Kenny. "How reliable are ATP bioluminescence meters in assessing decontamination of environmental surfaces in healthcare settings?" PLoS One 9.6 (2014): e99951.

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