Adenosine triphosphate hygiene monitoring – a real world study

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ATP sanitation monitoring systems have evolved into the current 'gold standard' for food and beverage production facilities to monitor their hygiene programme's effectiveness. Using an ATP system is an easy and quick measure of a facility's cleanliness, and is easily customised for the specific equipment, people, product, and processes used in any food production facility. The system enables you to set an objective, recordable and traceable standard to help avoid the costly consequences of substandard cleaning efforts.

The newly launched AccuPoint Advanced hygiene monitoring system from Neogen offers state-of-the-art samplers, a simple and accurate reader and new Data Manager software to effectively detect adenosine triphosphate (ATP) from food residues and micro-organisms present on surfaces and in liquids.

The robust handheld reader can be used to test virtually anywhere and produces fast results in less than 20 seconds. In addition, the system comes complete with user friendly Data Manager software which allows the user to create test plans to track, analyse and trend test results over time.

Whilst previous versions of the AccuPoint system have been very successful tools to monitor the effectiveness of cleaning programmes for many, the feedback received led directly to this next generation of AccuPoint system. Many years of working closely with the food industry, and other producers of consumer products, have shown the company what matters. Neogen are very pleased to offer a new hygiene monitoring system that they believe is superior to anything else on the market.

Company	Reader	Sampler	Mean RLU
Neogen	AccuPoint 3.04	AccuPoint Advanced	593.32
	Competitor A		871.56
	Competitor B		206.64
	Competitor C		29,809.04
	Competitor D		594.12

Table 1. Mean RLU response of five ATP monitoring systems against an ATP standard of 100 femtomoles.

What is ATP?

Adenosine triphosphate (ATP) is a compound found in every living cell and can be used as an indicator to determine whether a surface was properly cleaned.

ATP hygiene monitoring systems have been used in the food production industry for over 20 years.

The systems are used in facilities to measure the cleaning effectiveness, removal/reduction of ATP, on food contact surfaces.

Real world study

To validate the claim that AccuPoint Advanced is the superior hygiene monitoring system on the market, the Applied Research Centre at NSF International conducted a comparison performance study against four other commercially available systems.

The results were clear with Julie Vantine, Project Manager at NSF International concluding, "Neogen's AccuPoint Advanced ATP system consistently yielded the highest percent recoveries and the most consistent readings of the target analytes, when compared to the other four test systems."

Recovery test

The study attempted to mirror typical field usage by looking at the recovery of each system of ATP standards and commodities from a common surface (stainless steel).

Multiple manufacturers produce monitoring systems to detect ATP. The following series of dilutions were tested:

- 1:1000 (1 part orange juice to 999 parts sterile water).
- 1:5000 (1 part orange juice to 4999 parts sterile water).
- 1:10000 (1 part orange juice to 9999 parts sterile water).

Evaluation protocols

Evaluations of the sanitation systems were conducted in four sections.

Section 1 involved the addition of

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Fig. 1. Recovery of an ATP standard from a single contamination spot on stainless steel surfaces.

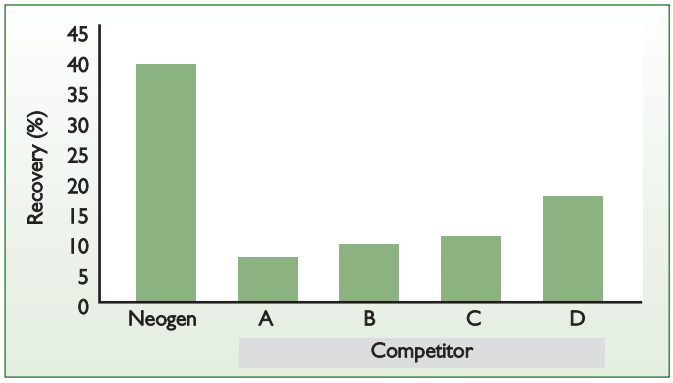
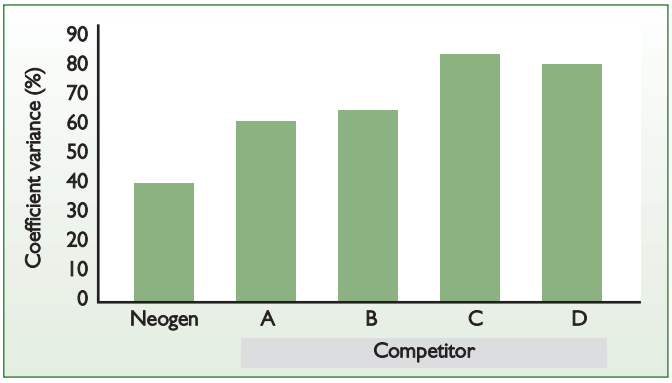


Fig. 2. Recovery of an ATP standard from a single contamination spot on stainless steel surfaces. Coefficient of variance (%) was calculated and lowest % indicates the most consistent (least variable) readings.



Company	Reader	Samplers	Mean RLU recovered from surface			% ATP recovery from surface
			Avg	Std Dev	CV (%)	Average
Neogen	AccuPoint 3.04	AccuPoint Advanced	165.2	34.87	21.11	27.84
Competitor A			62.8	20.08	31.98	7.21
Competitor B			31.1	18.62	59.86	15.05
Competitor C			8,618.10	5,236.99	60.77	28.91
Competitor D			123.7	47.34	38.27	20.82

Table 2. Recovery of ATP standards from a homogenously contaminated stainless steel surface.

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ATP standard solutions directly to sample swabs. Section 2 evaluated the recovery of ATP deposited over a 4"x4" stainless steel surface.

Section 3 evaluated the recovery of a concentrated spot of ATP randomly located on a 4"x4" stainless steel surface and Section 4 involved assessing the recovery of orange juice (commodity testing) deposited over a 4"x4" stainless steel surface.

Results and discussion

A comparative evaluation of the ability of five commercial ATP monitoring systems to accurately report ATP levels from stainless steel surfaces was performed.

The studies examined the difference in recovery of ATP standards when applied in a homogenous manner across the carrier as well as to a random spot contamination. The study also assessed the ability of the five ATP monitoring systems to detect a standard commodity food, orange juice, which was applied to carriers in varying concentrations.

During Section 1 of this study, the RLU (Relative Light Unit) outputs for the five test systems were observed when ATP standards were directly introduced onto the swabs/sample pads. The mean RLU output was calculated for 25 replicates and reported in Table 1.

Section two of the study utilised stainless steel coupons prepared with the 100 femtomole of the reference ATP standard as the sample.

The surface was sampled using the monitoring systems' operational instructions but utilising a real world approach to the exposure time of the swab contact on the sample surface.

A standard run/return pattern was used over the sample coupon on two axis/sides. Each side had the timed exposure of swab to surface of five seconds making the entire exposure 10 seconds.

This timeframe is relevant to compare the results of a laboratory study to a real world, situational use of the monitoring system. The percent of ATP recovered was determined by comparing the mean response from the surface recovery to the mean response of direct swab inoculation observed in Section 1.

Company	Samplers	Orange juice dilution		
		1:1000	1:5000	1:10000
Neogen	AP Advanced	1,783.4	418.5	90.7
Competitor A		3,629.1	832.6	217.5
Competitor B		639.6	165.6	34.0
Competitor C		145,735.9	34,517.6	6,394.1
Competitor D		2,071.9	582.4	139.9

Table 3. Recovery of ATP from stainless steel surfaces inoculated with varying concentrations of orange juice. Mean RLU for recovery of orange juice pipetted onto the sample pad/swab.

Assessing ATP recovery

Section 3 involved assessing the ATP recovery efficiencies from stainless steel coupons with a random spot of 5.0 nM ATP solution of 100 femtomoles dried on it. The surfaces of 10 replicant coupons were sampled utilising the real world situational sampling method utilising each of the five monitoring systems to determine the mean response of each unit.

The percentage recovery was calculated by comparing the mean response from the surface spot recovery to the mean response of direct swab inoculation observed in Section 1.

Neogen AccuPoint Advanced had the highest percentage recovery of all five monitoring systems at 40.50% recovery of the ATP solution from the unit surface.

The system exhibited a percent ATP recovery that was 2x's greater than the next most efficient monitoring system. It also exhibited the greatest consistency in readings (with a CV of 21.11%), indicating that the system is very precise. The next closest system was Competitor D's system at 17.93% recovery.

Real world scenarios

In Section 4 the experimental protocol was designed to mimic real world contamination scenarios. This study involved contaminating stainless steel surfaces with orange juice at three dilutions: 1:1,000, 1:5,000 and 1:10,000. RLU reference values for each dilution were first generated by direct inoculation onto the ATP monitoring system swabs.

Recovery sampling using a real world approach, as previously described, was performed on homogenously inoculated stainless steel surfaces. The percentage recovered from each surface was determined by comparing the RLU of the surface reading with the RLUs observed from direct swab inoculation.

Once again, the Neogen AccuPoint Advanced had the highest observed percentage recovery of all five monitoring systems. For each of the orange juice dilutions evaluated, the percent recovery of ATP by the Neogen AccuPoint Advanced was significantly higher than that of the other four ATP monitoring systems evaluated.

Once again, the Neogen Accupoint system proved to be the most consistent of the devices evaluated (with a CV of 40.58%). The next closest system for recovery at 1:1000 and 1:5000 dilution factors was Competitor D. For the 1:10000 dilution factor the second highest recovery was Competitor A.

Conclusion

In conclusion, across all real-world test simulations AccuPoint Advanced was more consistent and accurate in its detection of the amount of ATP on a surface with its larger sampler size.

In a production environment more accurate and consistent results mean more reliable data. This data can be used to make critical decisions such as whether to continue with a subsequent production run or delay that production until a second clean can be performed.

Reliable information can also result in the prevention of costly product recalls due to undiscovered contamination issues. ■

Table 4. RLU values observed from sampling 4"x4" stainless steel surfaces amended with three dilutions of orange juice.

Company	Samplers	Orange juice dilution								
		1:1000			1:5000			1:10000		
		Avg	ATP recovery (%)	CV (%)	Avg	ATP recovery (%)	CV (%)	Avg	ATP recovery (%)	CV (%)
Neogen	AP Advanced	553.3	31.03	33.1	119.8	28.63	46.7	14	15.44	146.7
Competitor A		71.4	1.97	74.3	48.2	5.79	32.0	26.6	12.23	111.52
Competitor B		65.7	10.27	37.2	27.9	16.85	43.3	0	0.00	NA
Competitor C		14,468.30	9.93	47.6	2115.4	6.13	36.5	14.4	0.23	316
Competitor D		271	13.08	55.3	148.1	25.43	38.8	10.5	7.51	31.2