WATER ACTIVITY BUYERS GUIDE

NEUTEC GROUP INC

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HOW TO CHOOSE A WATER ACTIVITY METER?

When it comes to water activity instrumentation, there are a lot of choices out there. The one that is best for you will depend on several factors. If you just want a number, there are cheap options that will give a number, but come with no support. If you pride yourself on reliability, but do not want to spend all your time maintaining the instrument, there are options as well.

The purpose of this guide is not to bombard you with reasons why one specific instrument is the best, but instead to honestly present the strengths and weaknesses of each sensor type so you can make an educated decision based on your own priorities.

The various instruments available in the market differ mainly by the type of sensor they utilize. Since within each sensor type there are instruments covering a range of accuracy, options, and price, this guide will focus on sensor type and not on specific instruments.

SENSOR TYPES

There are 4 main sensors that are used to determine the equilibrium relative humidity in the chamber:

01

THE ELECTROLYTIC RESISTANCE SENSOR

Tracks the equilibrium relative humidity changes by changes in the electrical resistance of an electrolytic solution.

02

THE HYGROSCOPIC POLYMER

Determines humidity by tracking changes in the electrical capacitance of a polymer that is equilibrated with the headspace humidity

03

THE CHILLED MIRROR SENSOR

The chilled mirror sensor determines humidity by determining the dewpoint temperature in the chamber along with the sample temperature

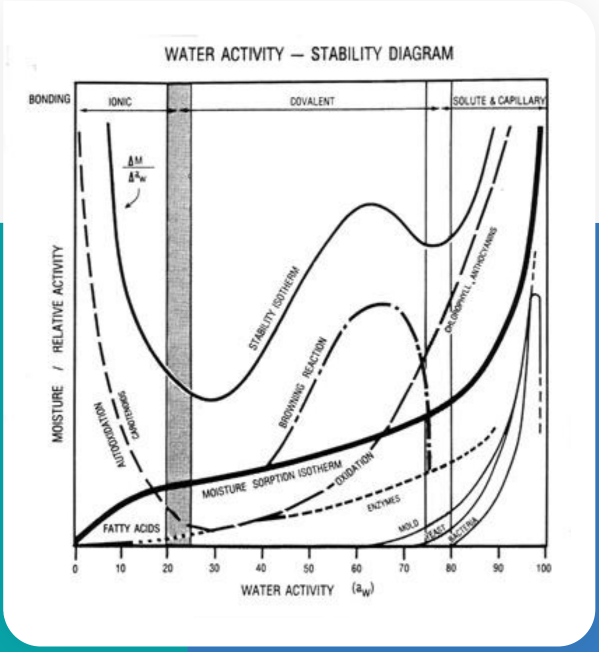
04

THE TUNABLE DIODE LASER

The tunable diode laser determines equilibrium relative humidity by the vapor density

PRIMARY VS. SECONDARY METHODS

Water activity is a measure of the energy status of water and is calculated as the partial vapor pressure divided by the saturated pressure at the same temperature. In practice, since the vapor pressure cannot be directly measured in the product, all water activity methods rely on placing the sample in a chamber and then waiting for the headspace to come to equilibrium with the sample so that the partial pressure in headspace is the same as the partial pressure in the sample. Then, the equilibrium relative humidity of the headspace is measured and when divided by 100, gives the water activity.



The various sensors used to measure water activity then only differ in how they determine the equilibrium relative humidity, making none of them a primary measurement of the vapor pressure in the sample, but all a primary measurement of equilibrium relative humidity. Consequently, any claims made of one sensor being primary vs. another being secondary is not critical to performance, but just marketing jargon.

READING VOLATILES

There is some confusion in the literature concerning the water activity testing of samples containing volatiles. The chilled mirror sensor in particular struggles with measuring volatile containing samples and there is no way to overcome this. The only choice is to use a different sensor. The same is true for capacitance sensors, although the impact is more delayed as the sensor becomes poisoned by absorbing the volatile. The electrolytic sensor will also be poisoned by volatiles and only the tunable-diode laser can handle volatile containing samples.

However, the electrolytic sensor from Novasina can be protected from volatiles using filters, making it possible to read most volatile containing samples. That means that the only sensor types that can actually read samples containing volatiles are the resistive electrolytic sensors from Novasina (with filters) and the TDL. Samples with volatile concentrations higher than 50% can only be read with the TDL sensor, but these types of samples are rarely targeted for routine water activity testing.

****Novasina also carries a special high Alcohol content sensor – please inquire**

ISSUES WITH 5 MINUTE TEST TIME CLAIMS

There can be an abundance of confusion with water activity sensors concerning test time. Some chilled mirror and TDL sensor instruments claim a 5-minute test time, while others offer fast or quick modes.

The truth is that water activity test time is determined by the sample and not the sensor.

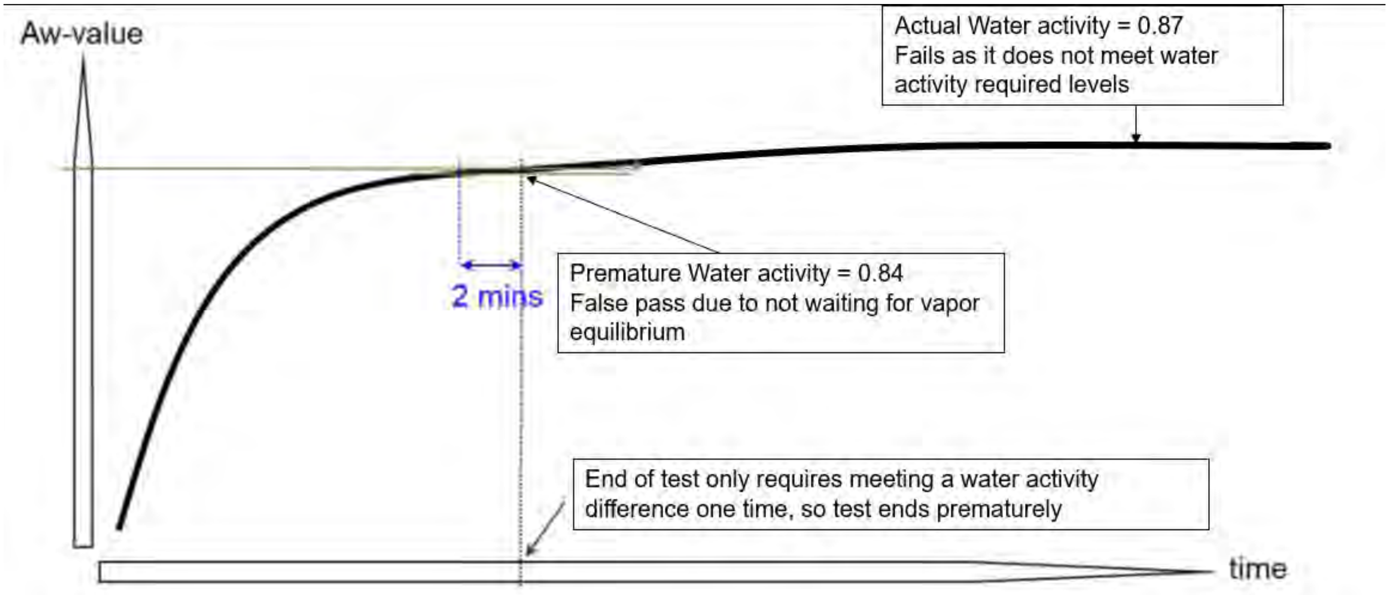
Since water activity is an equilibrium measurement, a reading is not complete until equilibrium has been achieved and this process cannot be sped up, so any claim to a specific test time is illogical and would only be true for select samples. The reality is that most types of samples require a minimum of 5 minutes or more to reach true equilibrium and test times that are faster than that are either using a prediction, or the system uses end-of-test settings that are not stringent enough to achieve true vapor equilibrium.

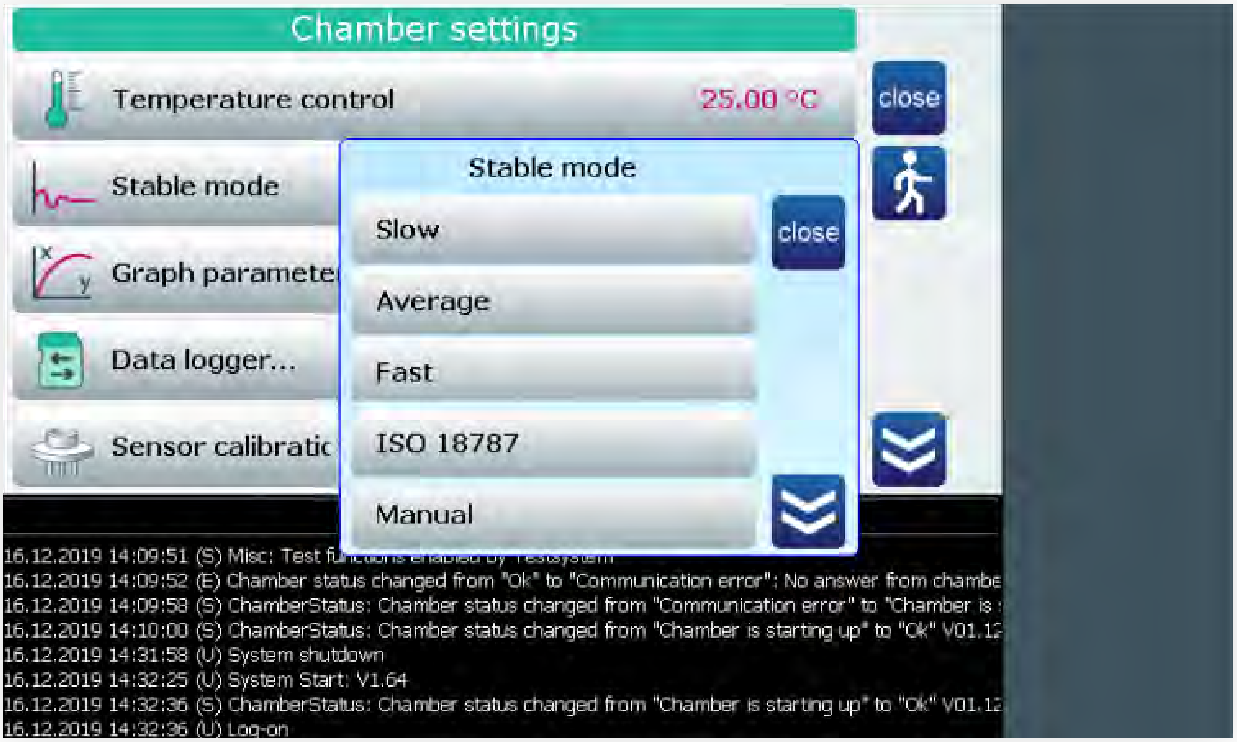
Low moisture, glassy food powders are an example of samples that require a surprisingly long time to reach true vapor equilibrium. A test run with a chilled mirror sensor or TDL will provide a completed reading in about 5 minutes versus an electrolytic sensor using the average mode stability setting will take about 30 minutes.

Why are the other sensors so much faster?

This can be discovered by simply repeating the test with the chilled mirror or TDL sensor for 30 minutes while tracking the result and an average of 0.01 aw drift can be observed.

This indicates that while a result was given by the other sensors after 5 minutes, it was not the true water activity and was prematurely ending the test.





The cause of these premature readings is that the end-of-test setting for the other sensors, which is set by the manufacturer and cannot be altered, is not stringent enough and can be too easily achieved. Conversely, the end-of-test setting for the Novasina electrolytic sensor can be adjusted by the user to be made either more or less stringent. For example, the average setting in the Novasina instrument requires no change in water activity greater than 0.001 for 4 minutes and repeated measurements using the electrolytic sensor will not show the drift seen with the other sensors because the setting is stringent enough to ensure true vapor equilibrium. The more stringent settings of the Novasina unit can result in longer test times, but they also provide a true water activity.

Any instrument can be made to provide fast read times by making the test requirements less stringent, but at what cost?

It is best to wait for true equilibrium and assure the highest accuracy possible.

CLEANING INSTRUMENTS

It is an undisputable fact that the chilled mirror and tunable-diode laser sensors, based on how they function, must be clean to provide good readings. Contamination will result in false determinations of vapor pressure and these sensors must be verified at least daily, if not more often, to make sure no sensor contamination has occurred that could be altering the readings. The electrolytic sensor from Novasina, and to a lesser extent the capacitance sensor, do not have these same challenges because reflection and emissivity are not part of the measurement process. In addition, the Novasina electrolytic sensor is isolated from the chamber behind a protective filter that prevents access to the sensor by the contaminates.

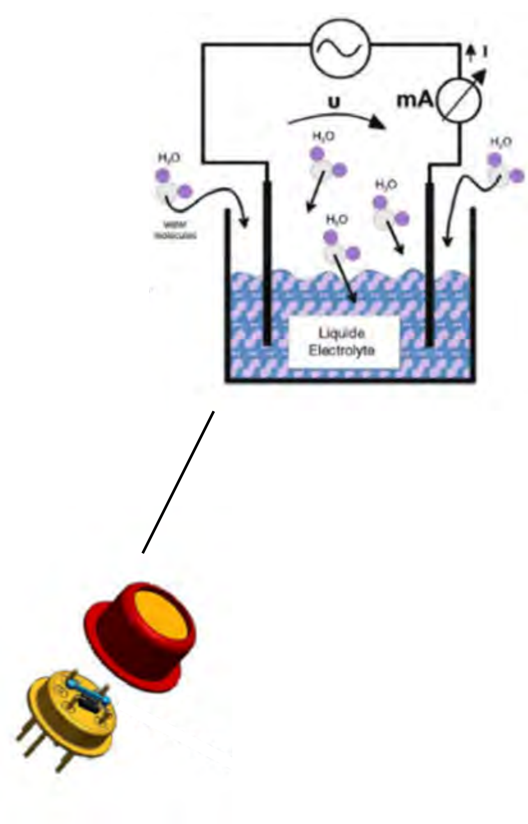
Recently, a claim was made that a dirty chamber caused more problems for the electrolytic sensor than it did for a chilled mirror sensor. The key here is a dirty chamber, not a dirty sensor. A dirty chamber containing contaminates will in fact impact the results of any water activity instrument by altering the vapor pressure in the chamber. But that is a much different scenario than just the sensor being dirty. **When the study is altered and the contamination is applied to the sensor, the chilled mirror and TDL sensors are no longer able to read the standards in tolerance, while the electrolytic sensor from Novasina is not impacted because the sensor is protected.**

SENSOR STRENGTHS AND WEAKNESSES

RESISTIVE ELECTROLYTIC SENSOR FROM NOVASINA

STRENGTHS

- High accuracy
- Low maintenance costs
- Routine cleaning not needed
- High level of instrument stability
- Can read volatiles with filters
- Wide price range of options
- Re-useable standards



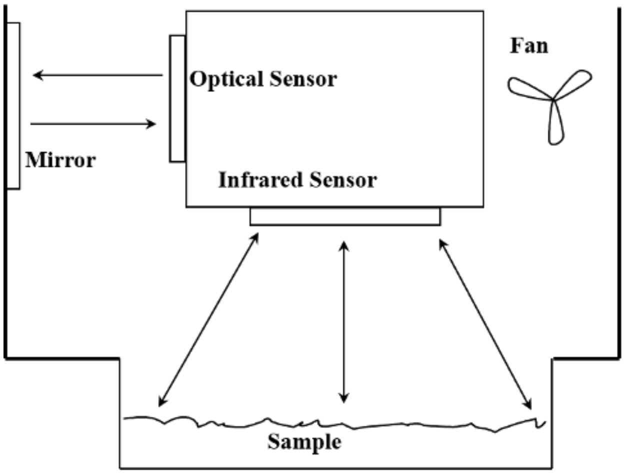
WEAKNESSES

- Volatiles require filters
- Stringent end test requirements
- Extended read times with stringent settings

DEW POINT SENSOR STRENGTHS AND WEAKNESSES

STRENGTHS

- High accuracy
- Fast read times
- Wide price range of options



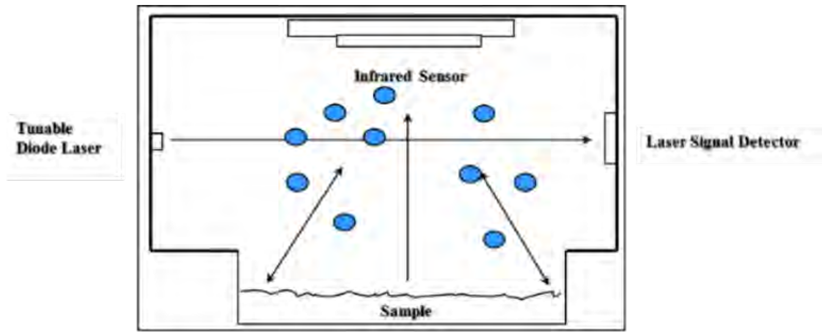
WEAKNESSES

- Premature results
- Cannot read volatiles
- High maintenance requirements
- Expensive consumable standards
- Low stringency equilibrium settings

TUNABLE DIODE LASER (TDL) STRENGTHS AND WEAKNESSES

STRENGTHS

- Can read all volatiles
- Fast read times



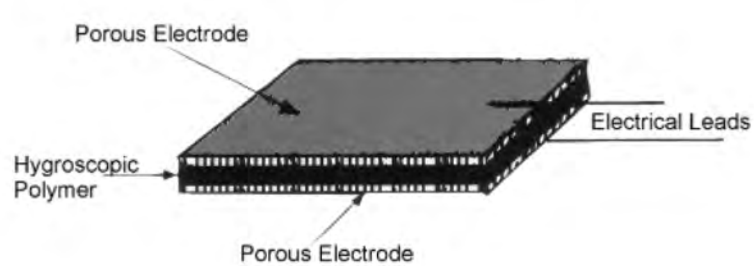
WEAKNESSES

- Expensive Technology
- Expensive consumable standards
- Impacted by changes in pressure
- High maintenance requirements

HYGROSCOPIC POLYMER CAPACITANCE SENSOR STRENGTHS AND WEAKNESSES

STRENGTHS

- Low cost
- Can read some volatiles



WEAKNESSES

- Sensor hysteresis
- Low accuracy
- Tests results often predicted
- Sensor fails with prolonged exposure to volatiles

SUMMARY

Method	Instrument Stability	Analysis Time	Accuracy and Precision	Maintenance	Interference by Volatiles	Cost
Electrolytic	1	3	1	1	3	2
Dew Point	3	1	1	4	4	2
TDL	4	1	3	3	1	4
Capacitance	2	4	4	3	2	1

AVERAGE RANKING RESULTS:

1. Electrolytic sensor
2. Dew Point Sensor
3. TDL Sensor
4. Capacitance

Based on this investigation of the various sensors for measuring water activity, each has its own strength and weaknesses and no one sensor type was ranked first in every category. When deciding which water activity sensor will work the best for your application, it is important to weigh the strengths and weaknesses of each sensor and choose the one that best aligns with your needs.

If an average of all rankings is taken, ***the electrolytic sensor from Novasina*** *does line up as the top ranked sensor across all the categories considered important when deciding which water activity instrument to buy.*

THIS ELECTROLYTIC SENSOR CAN BE FOUND IN THE FOLLOWING NOVASINA MODELS:

CLICK THE IMAGE TO LEARN MORE

www.neutecgroup.com

sales@neutecgroup.com

"… within five minutes, I was able to figure out how your system functions. It was like, it slapped me in the face, how easy it was to understand. …everything was just so precise right on. So, it seemed like we had struck gold on an instrument that was accurate, precise, robust, and rugged, and not conducive to just working between the hours of eight and five. I mean, she rants and raves about finding that piece of equipment because it makes her life so much easier

MIKE SMOLEY,

Validation Program Manager Minnesota Valley Testing Labs (MVTL). New Ulm, Minnesota

We have been using the LabMaster-Neo quite a bit to characterize our samples. It is very easy to use and does not take up much space. It was well worth the purchase!”

VASU SETHURAMAN,

Principal Scientist, Synlogic, Cambridge, MA

“It’s definitely one of the simplest analyses to run for us, which is great. And again, because it has implications on other results, it’s a great way for us, say if we’re able to run water activity on a sample that we got the day of, but we know that our other analyses, which take a lot longer are not going to give us results yet we can kind of know or make assumptions about what the results might look like, which is great”

CASEY SLEZAK,

Modern Canna laboratories, Lakeland FL