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Home of the Atmox Crawl Space Ventilation System

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## Trigger Points for Condensation in a Crawl Space

*Or why some crawl spaces (CS) have excessive surface moisture (sweat) and others next door don't.*

Let's establish a few plausible assumptions:

Footprint of CS	2500 ft <sup>2</sup>	232 m <sup>2</sup>
Average height	2.5 ft	0.75 m
Volume	6,250 ft <sup>3</sup>	174 m <sup>3</sup>
Average Water layer thickness (sweat)	.039"	1mm
Total water volume of that layer	64 gal	232 lt
Average outside Temperature	85°F	29.5°C
Average inside Temperature	70°F	21°C
Average wind speed (urban area)	3 mp/h	5000m/h
Average openings on one side of a house	4	4
Available pass through area of these openings	200 in <sup>2</sup>	0.13 m <sup>2</sup>
Max. air inflow per hour		650m <sup>3</sup> /h

More realistic airflow with all obstacles, such as HVAC ducts, height of crawl space, shrubbery taken into consideration

	<b>7,000 ft<sup>3</sup>/h</b>	200 m <sup>3</sup> /h
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Most studies for natural air circulation were done for live stock and very few for crawl spaces. Above assumptions, nor the following narratives, are based on scientifically documented research. However, many sources of research have influenced our thinking, but mostly our own observations of hundreds of crawl space "visited" over the past years. And Physics 101 is strictly applied!

There is a difference in the capacity to absorb water molecules depending on air temperature. Warmer air can absorb considerably more water. That difference for summer time weather at the East Coast is about 30 grams between 70°F (21°C) and 90°F (32°C) per 1 m<sup>3</sup>. Hot air flowing through the cooler crawl space will of course never deposit all 30 gr of water on the cooler surfaces. If we reckon with 33% "process efficiency", we can assume 10 grams of water are being deposit by every 1 m<sup>3</sup> (35.3 ft<sup>3</sup>) of hot air that can flow into the crawl space. We would need 23,200 m<sup>3</sup> (810,000ft<sup>3</sup>) of air to carry 232 liters into the crawl space. That is a lot of air! But it would take only about 116 hours (5 days) to achieve that with a steady flow of air. As we all know, summer winds are not constant (or even missing

during the stifling hot days) we most likely have to extend the 5 days to 3 weeks during which the outside dew point is higher than the inside dew point. We know from our own measurements that the dew point inside the cooler crawl space hangs around 68°F, which corresponds to 90% humidity.

**That is why it is so important that power fans have to be controlled. Just one power fan with approx. 300 cfm would move the same air quantity needed to deposit the full water film in roughly 45 hours.**

**A fan controlled by an inside humidistat (or no controls at all) is the worst you can do to your crawl space!!**

In most cases there are other circumstances that accelerate the build up of surface moisture. "Water sources" on the inside and outside of the crawl space are often to blame:

- For example an HVAC air handler, which is not properly discharging or draining the condensate. It is estimated that an HVAC unit produces about 600-800 gallons of water during one cooling season. That water comes from vapors produced inside the house by cooking, taking showers and water molecules infiltrating from outside (including the crawl space). The very cool heat exchanger inside the air handler, will extract the water out of the air that circulates in the house. It would only take a fraction of that water to create a sweaty condition inside the crawl space. Unfortunately we see problems with the air handlers very often (drainage plugged up or a defective condensate discharge pump)
- A broken water or sewer line.
- Standing water of any kind is an absolute no-no!

From the outside there can be several culprits:

- A sprinkle system not properly adjusted or running too long.
- Water infiltration after a heavy down pour (down spouts not leading away from the house).
- A deck that retains a lot of moisture in the ground.
- HVAC condensate discharge not properly guided away from the house (water finds its way back into the crawl space).

Any water that makes it into the crawl space will accelerate the formation of a film of surface water. Standing water, puddles, but even a lot of water embedded in the soil and walls can have a detrimental effect.

Once the sweating and dripping starts, it will usually accelerate real fast. One of the reasons is a feature that should have prevented the sweating in the first place: the vapor barrier. If water starts to puddle on top of the plastic it remains part of the vicious circle. It would be better to cut small holes where the puddles are and let the water run under the plastic where at least it has a chance disappear into the soil and be retained by the 99.9% rest of the vapor barrier!

Every time the water evaporates from a surface it needs energy, which is drawn from the surroundings. The result is a cooling effect and that also cools the surfaces. More water will condensate brought in by warmer air with a higher dew point.

**The only conclusion:**

**Prevent water from getting into the crawl space, either liquid or in form of vapor.**

If power fans are installed and properly controlled (as with the ATMOX system), the fans will remedy the situation in a day or so if enough dryer outside air is available. However, Mother Nature cannot guarantee that during the summer. Ventilation alone will not be enough during an extended period of time when dryer air is not available, and especially if the situation is aggravated by one of the above mentioned possible sources of water.

Therefore, an “incorporated” dehumidifier would be the next best thing. If that dehumidifier can be used to avoid any condensation in the first place a disaster can usually be prevented. The dehumidifier is best used when the inside relative humidity climbs above 90%. 90% humidity relates to 16-17% wood moisture and any home inspector will acknowledge that that 17% is excellent during the summer months. However, if the dehumidifier runs too long and dries out the wood too much, other problems can occur such as dry rot. Also disturbances in the substructure and wood floors can be observed when the wood expands and contracts too much.

**Mold and Mildew**

There is no way to “dance around” the problem of mold and mildew growing in your crawl space. Unless you “kill” it, it will grow! The same way it will grow right outside your house! The question usually us how much, and is anybody affected by it? Some species only need little moisture to propagate; others (and mostly the bad stuff) need extended periods of water available. That is why an unnoticed broken water pipe will very often result in a sever mold problem, not only in a crawl space, but also inside a wall.

Almost all mold experts (including the EPA) recommend as much ventilation as possible to prevent excessive growth of mold and mildew. The same is true for a closet or cabinet inside an air-conditioned bedroom or kitchen.

Mold needs nutrients provided from the surface it growths on. In a crawl space that surface can be treated to prevent to mold and mildew to establish itself:

- In the South, any new structure should be treated against mold. There are a variety of products on the market claiming to be environmentally friendly and affordable (FortiCell, Timbor, BoraCare). The treatment should be done as early as possible during construction and should be done by a trained expert. Water penetration in buildings under construction is a constant dilemma and if the builder is not careful mold can establish itself very early on!
- In an older house (Crawl spaces and basements) the following should be done:

- Remove all debris and organic matter from the crawl space, especially wood pieces and carton boxes.
- Re-install the insulation, so they fit snug against the sub-floor.
- With a HEPA vacuum cleaner remove all existing mold (wear protective gear)
- Spray against mold to prevent any further growth.

Note: It is advisable to hire a mold remediation company that has all the proper equipment to perform the last two steps mentioned above. Even for the first two steps please protect yourself accordingly.