An Analysis of the Desert Spring Humidifier

For:

Desert Spring Products Limited
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Tang Lee is a professor of building science and environmental health for over 25 years at The University of Calgary. He also holds or has held academic appointments at several other universities including those in Manitoba, California and Hong Kong. Tang Lee designs and conducts research on sustainable buildings to minimise indoor contaminants and to demonstrate ecologically sensitive designs. He is qualified as an expert witness in civil and criminal cases in the area of building regulations, building science and indoor air quality.

Professor Lee chaired the Canadian Construction Research Board in Calgary, is on the editorial board for several scientific publications and several committees of the National Research Council of Canada and Health Canada. He updates training manuals on behalf of the Safety Codes Council for Safety Codes Officers. Tang Lee is a member of the Healthy Indoors Partnership, and appointed to the *Health and End User Advisory Committee* of Health Canada and the National Research Council of Canada. In 1997, he was made honorary member of the American Academy of Environmental Medicine, and a member of the international faculty of the American Environmental Health Foundation.

TERMS OF REFERENCE

Tang G. Lee, Professor of Environmental Design, University of Calgary, was retained by Desert Spring Products in July of 2003, to prepare a study on the Desert Spring Humidifier System. Specifically the task was as follows.

> *To examine the Desert Spring Humidifier Model DS2001/DS3200 and to determine its inherent properties in comparison with other home type humidification devices. Comparison will be made to the typical drum, evaporator pads, steam, flow-through, etc. humidifiers. This evaluation will focus on the potential for mould formation and dispersion as this can be one of the major problems with humidifiers. Other characteristics include maintenance and amount of water consumed. The typical portable room humidifiers are also examined in comparison with the Desert Spring Humidifier.*
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> *The evaluation does not include any testing, monitoring, or analysis of electrical components including safety issues. This evaluation will not compare cost of the units nor installation techniques as these will change over time. Any recommendations for improving the product may also be identified.*

This report summarises findings from the examination of the Desert Spring humidifier system as compared to other humidifier technologies.

1.0 INTRODUCTION

Humidifiers are a necessary component in most buildings. Building enclosures separate indoor and outdoors environments to provide optimal comfort for its inhabitants. Obviously this must be a selective separator, to keep out harsh elements but permit the entry of sunlight and fresh air. In the winter, the cold outdoor air must be brought into the house to replenish the oxygen consumed by the occupants, and also to dilute the air contaminants. When cold outside air is heated to room temperature, the relative humidity decreases substantially as the warmer air can retain more moisture. Unfortunately the resulting low relative humidity will cause not only human discomfort but can also dry and damage some building contents. In addition, static electrical discharge in dry buildings will be uncomfortable to occupant but can also damage sensitive electronic equipments such as computers and medical devices. Humidification therefore is required in any building that requires an outdoor supply air and located in cold climates.

The concern with the humidification of buildings is to ensure that the humidification system can be easily maintained and not cause other problems. These problems include the following and will be discussed later.

1. Excessive humidity
2. Mineral build-up
3. High energy consumption
4. Mould growth in standing water
5. Wasting water, and
6. Maintenance

2.0 COMMON TYPES OF HUMIDIFIERS

There are available several technologies to humidify a building. Each humidifier technology has its inherent advantages and disadvantages. The common humidifier technologies are as follows.

- **Evaporative:** An evaporative humidifier depends on airflow to pick up the moisture from a wet medium and transmits the moisture invisibly into the air. The medium wicks up water through capillary action from a reservoir. Moisture is diffuse into the building via airflow across the moist medium.
- **Ultrasonic:** High speed vibrations called ultrasonic vibration cause the water to break up into fine mist. Airflow blown across the water surface carries the mist to humidify the building.
- **Cool mist impeller:** As with the ultrasonic type of humidifiers, water is broken into fine mist by means of centrifugal force. Airflow blown across the water surface carries the mist to humidify the building.
- **Steam vaporisers**: Using the principle of boiling water that releases steam into the air, this type of humidifier adds moisture to the air. An electrical heating element or electrodes is commonly used to boil the water – consuming considerable amount of energy.
- **Warm mist humidifiers**: Similar to the steam vapourisers, warm mist humidifiers heats water in a small heating chamber or tray to transmits moisture into the air.
- **Portable humidifier**: All of the above types of humidifier can be used as a potable, room-type humidifier. These are useful for places where access to the central forced air system or air-handling system is restricted such as in apartments. These are fairly cheap and can be moved from room-to-room.

2.1 Inherent problems with different types of humidifiers

- **Evaporative:** Among the more serious problems of the evaporative humidifier is its dependency on the ability of the medium to wick-up or pick up the moisture from the water reservoir. Most places have hard water that can coat the medium with minerals, thus reducing its effectiveness. The medium requires periodic

replacement in order to optimize performance. Some evaporative humidifiers drip water across the medium and what is not dispersed into the air is drained away, wasting a considerable amount of potable water.

- **Ultrasonic:** The mechanisms to produce the high speed vibrations are delicate moving parts that can break down due to material fatigue. If the vibration is too slow, larger water droplets can disperse into the air where it can collect downstream of the humidifier, causing rust, rot and material degradation. With standing water in these locations, mould can also propagate.

- **Cool mist impeller:** Similar to the inherent problems of the ultrasonic humidifier. The high speed spinning produces sound that can be disturbing to some occupants if not installed and isolated properly. Misting nozzles are very small and can plug up due to mineral build-up and impurities in the water.

- **Steam vapourisers**: As noted earlier, the electrical heating element or electrodes consume a considerable amount of high grade energy. Hard water also causes the electrodes to calcify, reducing the effectiveness of the heating element even though the energy consumed is identical. Maintenance is very high on these types of humidifiers.

- **Warm mist humidifiers**: Similar to the steam vapourisers, the water heating consumes electrical energy, and the mineral build-up on the electrodes is a serious maintenance problem.

- **Portable humidifier**: While cheap and useful in certain applications, the portable humidifier will have the same problems as the above units. In addition, the water reservoir is rarely cleaned or dried to remove mineral build-up and has the potential for micro-organism growth.

In summary, all humidifiers have some or all of the following inherent problems.

1. **Producing excessive humidity**
   Condensation in buildings is a serious problem. In cold climates, the building envelope must be above the dew point temperature to prevent the formation of condensation. This requires a good thermal barrier and no thermal bridging. Furthermore, the building envelop must not permit air leakage as such conditions will transport moist air into the walls and ceiling to form interstitial condensation.

   Unfortunately buildings may not be built to exacting standards of insulation, thermal bridging and air tightness. High indoor humidity can compromise the integrity of the building envelop, increase heat loss and cause mould growth.

   Human activities in the building will also generate humidity. Activities such as washing, bathing, cooking and even hobbies such as an aquarium and exercise can raise the humidity level. With the humidifier, it is important that a humidistat be used to maintain a relative humidity level that can be

tolerated by the building as designed and built. The level of indoor humidity must be carefully controlled to avoid reaching the dew point temperature at which point condensation will form.

Most agencies such as the American Society of Heating, Refrigeration and Air-conditioning Engineers (ASHRAE) recommend that indoor relative humidity levels should range up to 60%, or even higher. Health Canada recommends a relative humidity range of 30-55%. My recommendation is that relative indoor humidity levels be kept below 40% relative humidity for most regions in Canada. Obviously with warmer outdoor temperatures, the indoor relative humidity can be adjusted higher. As most humidifiers are installed with a humidistat, it is incumbent for the occupant to adjust the indoor relative humidity according to the outdoor temperature.

2. Mineral build-up

A certain amount of trace minerals in our water supply is necessary for human health. Unfortunately the minerals can be deposited in the humidifier evaporator pads, in the water reservoir and in other components. This mineral build-up will reduce the effectiveness of the evaporator pads to pick up and disperse moisture.

3. High energy consumption

Most effective humidifiers will require some mechanism to help vapourise the water, either by boiling, misting, or dipping into the water reservoir. These will consume varying amounts of energy depending on the design and efficiency of the mechanisms. The energy required to boil water is very high and with increasing electrical cost and the depletion of conventional fuels, we must select components that are more energy conserving.

4. Mould growth in standing water

Among the more serious health problems impacting occupants are the species of moulds producing mycotoxin. With over 10,000 lawsuits in the United States, and over 30 cases in Canada on moulds alone, we must ensure that the humidifier does not become a breeding ground for mould propagation. Since moulds grow in standing water, the water reservoir in humidifier can be problematic. At ideal temperature, warmer than 30 degrees C, mould growth can accelerate to maximum growth within 24-48 hours. Thus water in the reservoir cannot be allowed to remain in the reservoir for longer than a couple of days. Adding fresh water to the reservoir is insufficient to prevent mould formation as some of the old water remains in the reservoir. Ideally there should be no standing water. Alternatively the reservoir water should be drained within a couple of days at the most.

5. Wasting water

The United Nations issued a concern at the Johannesburg Summit in 2002 that gave a dire warning about the depletion of potable water. Potable water is a valuable resource and cannot be squandered by flushing it down the

drain. Some humidifiers such as the flow-through types allow the water that is not dispersed into the air, to drain away. This technology should not be permitted by the municipalities as the cost of providing water treatment plants and the infrastructure are becoming very expensive. When many flow-through humidifiers are installed, the accumulated consumption of potable water is intolerable and should not be permitted by any municipality to continue to be used or installed.

6. Maintenance

As with any mechanisms, components will eventually reach the end of its service life. However, a properly designed humidifier, with the selection of proper materials, can last for decades. As noted earlier, inherent with the use of city water is the potential of mineral build-up on the components. Such build-up reduces the effectiveness of the evaporator pads, the misting components, the heating elements and even the reservoir trays. The only means to prevent mineral build-up is to use distilled water but such water is expensive and requires a great deal of energy to create.

Mineral build-up drum style evaporators will accumulate in places where the water dries out, leaving the mineral deposit behind. When the motor is activated, the off-balance may create enough stress to overwork the motors, reducing its service life.

Must we accept these deficiencies of the inherent problems with the many different types of humidifiers? Fortunately there are alternatives to the selection of humidifiers that can minimise the inherent problems of humidifiers.

The Desert Spring humidifier with their proprietary rotary disc evaporator, and the automatic flush feature, can help address most of the inherent problems of the typical humidifier.

3.0 Desert Spring humidifier
The Desert Spring humidifier with the Rotary disc evaporator and the automatic flush feature has several advantages in optimal performance, minimising mould growth and reducing water consumption. These features will help maintain occupant comfort, health and well-being, and minimise our ecological footprint.

3.1 Rotary disc technology.
A key component of the Desert Spring humidifier is the innovative use of a plastic disc that picks up water from a reservoir. When air is passed through the discs, moisture is transferred to the air to humidify the building. The small spacing between the discs is designed for optimal moisture transfer. Too wide a gap will create laminar airflow that will not effectively pick up the moisture. Too narrow a gap will create static air pressure that the furnace blower may not overcome. With the spacing calibrated for airflow, a considerable surface area of the discs will contact the air to enable moisture transfer.

The solid plastic discs are considerably more durable than the foam type of evaporator pads and drums. It is highly unlikely that there will be any need to replace or adjust the discs. In examining the Desert Spring humidifier in use, we found there is just a light dusting of minerals on its surface. The amount of minerals on the surface does not reduce the area of wetted surface for moisture transfer. In fact, the light minerals deposits on the surface may actually increase the surface area for wetting. Comparatively, foam evaporator pads found on drum style humidifiers will plug up, the tiny holes becoming filled with minerals and significantly reducing the area for moisture transfer.

The amount of mineral build-up on the rotary disc is limited by the washing action as it dips into the water reservoir. Minerals washed from the discs to settle onto the bottom of the reservoir. The reservoir is shaped to collect the minerals into a lower area where it can be drained out.

3.2 Automatic flush
One of the concerns in mould growth in buildings is the amplifiers source. Any standing water is a potential mould amplifier. Any humidifier that allows water to remain in the humidifier trays will have micro-organism growth. The water must be completely drained and replaced with fresh water periodically. The Desert Spring humidifier uses an automatic flush mechanism that drains the water completely. At the same time, some fresh water is added to help flush out any debris such as mineral deposits in the reservoir. About one gallon of water is consumed in this process, which cannot be considered a waste as it serves an important function.

It is unlikely with this system design that the standing water will become mouldy after a couple of days in the humidifier reservoir. As such, the automatic flush can be set to drain the reservoir after two days to conserve even the small amount of water used for flushing.

3.3 Accessibility and maintenance

One of the useful features of the Desert Spring humidifier is the transparent cover that allows the building owner to check on the condition of the humidifier. With one glance, the building owner or operator can see if the discs are rotating, identify if there is any debris that requires cleaning, and confirm proper functioning of the water filler mechanism, etc. If servicing is required, the transparent cover can be easily removed to expose all the components. Everything in the humidifier is designed for ease of servicing and accessibility including removing the entire disc wheel assembly using a simple lift out procedure.

There is very little in the Desert Spring humidifier that requires servicing. In time, the motor and gears may require replacement, as is the standard water fill mechanism. There are no small misting nozzles to plug up, there are no evaporator pads or drums to replace, and there are no heating elements to calcify.

3.4 Water conservation

A major concern with humidifiers is the amount of water that they may consume. When water is used to directly humidify the air, it is not considered a loss. However, any water that is not converted to humidity is wasted. The general public and the government may not have any concept of the amount of water wasted by some humidifiers. With some types of flow-through humidifier, the amount water consumed within the home exceeds the amount of water used for flushing toilets and even for washing. With depleting amount of potable water, we must not waste water in this manner.

4.0 CONCLUSIONS

Humidifiers are necessary in our buildings to maintain occupant comfort and health. Some types of humidifiers can compromise health due to micro-organism growth. Others can cause material rot and rust due to excessive large water droplets. Some humidifiers waste a considerable amount of potable water. Potable water should always be used as efficiently as possible when used to humidify the air.

The Desert Spring humidifier addresses many of the problems in traditional humidifiers. The Rotary Disc technology is a durable and effective means to transport moisture into the air without sacrificing large volumes of water, and continues to function effectively with minimal maintenance and even in the absence of an external heat source. The automatic flush mechanism is necessary to prevent the amplification of moulds that can grow in water reservoirs. The flushing action also removes any accumulated mineral deposits and debris that may settle onto the reservoir.

The Desert Spring humidifier with their proprietary rotary disc evaporator, and the automatic flush feature, can help address most of the inherent problems of the typical humidifier.

In consideration of the six key challenges related to humidity within the indoor environment, the following comments apply.

1) **Excessive Humidity.** The Desert Spring humidifier system is controlled by a humidistat to regulate humidity levels.
2) **Mineral Build-up.** By design the Desert Spring evaporator sheds minerals which are periodically removed by the automated flushing mechanism;
3) **High Energy Consumption.** Only 4 watts of power are used to operate the Desert Spring humidifier.
4) **Mould Growth in Standing Water.** Potential for mould growth is minimised through periodic water changes facilitated by the automated flush mechanism;
5) **Wasting Water.** The Desert Spring humidifier wastes no water in it’s production of humidity.
6) **Maintenance.** By design, the Desert Spring requires minimal maintenance and there are no filters / pads / screens to replace.

As a result of my study I find that the Desert Spring humidifier system is worthy of consideration for enhancing humidification within indoor environments where and when this is required. It represents an effective environmental solution of all of the humidifier types that were considered within the scope of this study. It has been designed with consideration to promote healthy indoor air quality (IAQ).

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