



Response Time to Flow Changes in a Heated Passover Humidifier



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Background

- ◆ Heated passover humidifiers heat and humidify by directing gas over a heated water-gas interface (water chamber or wick)
- ◆ As gas flow increases over the water-gas interface, a servo control increases the water temperature to maintain temperature
- ◆ During mechanical ventilation changes in inspiratory flow can be immediate and large – from zero flow to 60 L/min within 1 second

Objective

To characterize the response time of a commonly used heated passover humidifier to abrupt changes in flow.

Methods

◆ A commonly used passover humidifier (MR 850, Fisher & Paykel, Irvine, CA) with chamber (MR 290, Fisher & Paykel, Irvine, CA) was exposed to an initial gas flow of 5 lpm. The chamber was connected to a dual limb heated wire circuit.

◆ Gas temperature and relative humidity (RH) were measured at the patient wye using a high-precision capacitive humidity/temperature sensor (SHT-75, Sensirion, Westlake Village, CA).

◆ Chamber water temperature was also monitored with a temperature sensor (Fluke, Everett, WA).

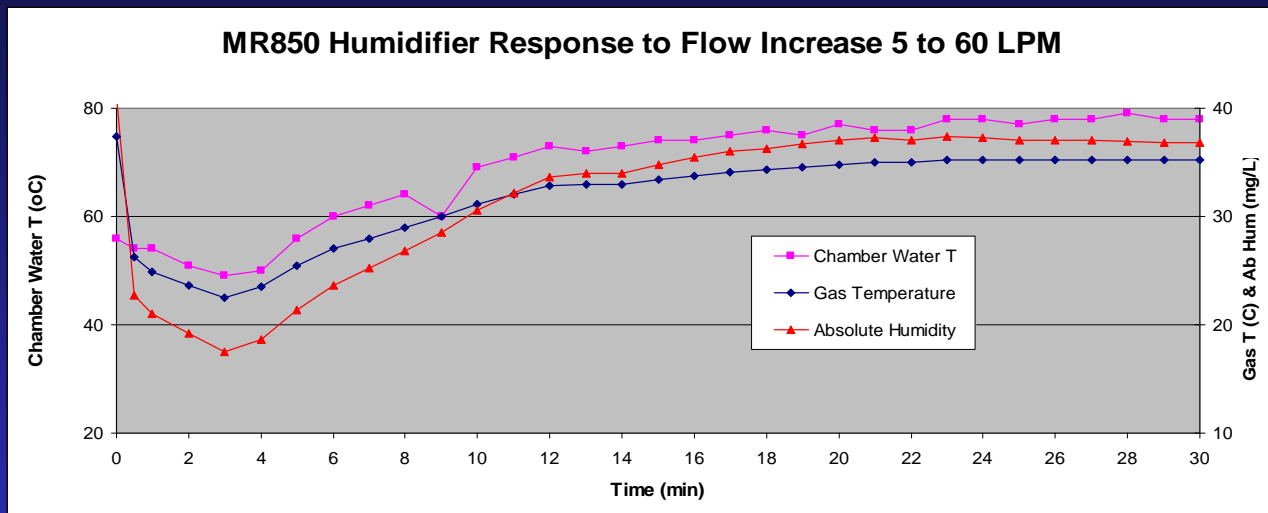
◆ Source gas (<3% relative humidity) flow was measured by an electronic flowmeter (TSI, Shoreview, MN).

◆ Gas flow was increased rapidly (within 2 seconds) from 5 lpm to 60 lpm.

◆ Measurements were taken at 30 seconds, 1 minute and then every minute thereafter to the end point of 30 minutes.

◆ Absolute humidity was then calculated at each point from the formula: $AH = ((0.00031243 \cdot T^3) + (0.0081847 \cdot T^2) + (0.32321 \cdot T) + 5.018) \cdot RH$

Results



◆ Gas temperature at 30 seconds dropped 11.2 degrees to 26.2°C and dropped to the lowest of 22.5°C at minute 3

◆ At 30 seconds the absolute humidity of the gas decreased from 40.9 to 22.7 mg/L with the lowest recording at 3 minutes (17.5 mg/L). Absolute humidity increased to AARC guideline minimum levels (30 mg/L) at 10 minutes and stabilized at approximately 40.4 mg/L after 21 minutes.

◆ Chamber water temperature started at 56.1°C (5 L/min) decreased to a low of 50.6°C at minute 3 then increased and held to 82.0°C to 83.0°C at 14 minutes and beyond. There was a 2 degree drop at 30 seconds.

Conclusions

- ◆ The response time of this passover humidifier to increase chamber water temperature may be too slow to maintain absolute humidity levels during changes in minute ventilation that can potentially occur over a sequence of successive breaths.
- ◆ Abrupt flow rate changes may potentially overwhelm the ability of the humidifier to provide humidity during periods of high inspiratory demand.