Blender Products Inc.

Enhance the Financial Attractiveness of your HVAC Application by Extending Economizer Operations and Integrating a Channel Blender® into an AHU

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Background:

AHUs using airside economizers to combine the correct balance of outside and return air have been around for years, operating in a wide range of climates and facilities. The primary benefit of airside economizer systems is the use of outside air to satisfy the building cooling requirements without the use of mechanical cooling, thereby realizing significant energy savings. Unfortunately, economizer operations are frequently abandoned in cold weather climates due to temperature stratification and potential to cause damage to downstream coil sections. This technical bulletin aims to address the energy savings that exist when addressing the root-cause of temperature stratification and integrating a Channel Blender® inside an economizer section.

To help demonstrate the impact of temperature stratification see case study below. A standard mixing box configuration exists with OA entering the top and RA entering from the back wall. The supply air temperature has a setpoint of 55°F, with 44,000 CFM required to serve the space. Below is a summary of the air inlet conditions for the mixing box:

- Supply Airflow: 44,000 CFM (55°F)
- Min OA Flow: 11,000 CFM (16°F)
- RA Flow: 33,000 CFM (70°F)

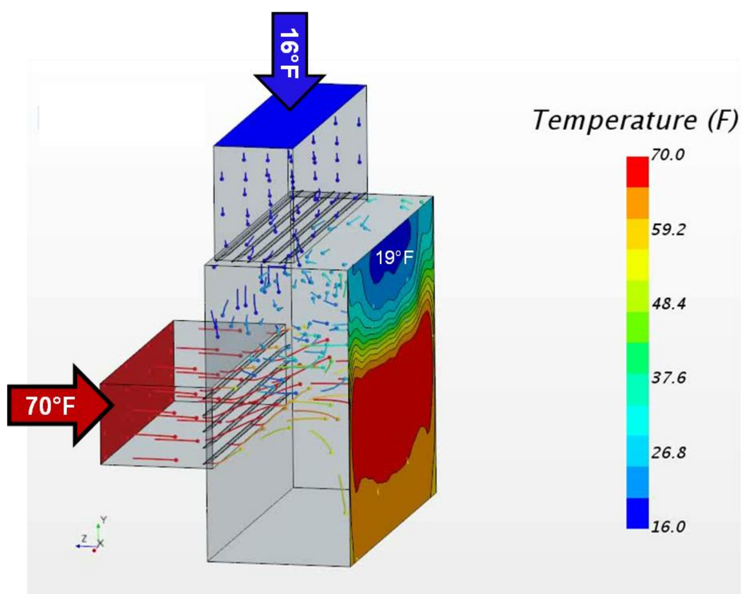


Figure 1. CFD Simulations Showing Temperature Stratification inside Mixing Box of AHU

Contrary to common practice, no orientation of the OA and RA dampers in the mixing box walls can effectively address the temperature stratification that exists. Therefore, the control system will detect low temperature alarms, forcing building operators to prematurely abandon economizer operations (i.e., add heat). In practice, 25% min OA @ 16°F would cause a freeze stat alarm and additional cooling would be required to reach the supply air temperature setpoint. The Channel

Blender® provides building operators the full use of economizer operations and provides "free cooling", which leads to lower overall energy consumption, lower operating costs, and improved IAQ.

Increase Economizer Duration:

Only proper mixing of return air and outdoor air can directly address the root cause of stratification inside an AHU. Installing a Channel Blender® inside the same mixing box above, raises the minimum temperature from 19°F to 46°F and provides a smaller temperature gradient at the exit of the mixing box. The Channel Blender® does not require additional tunnel length to provide effective air mixing. It's worth noting, there is no compromise in functionality or control of the OA & RA damper sections. At a supply airflow of 44,000 CFM and 25% OA, the pressure-drop to the system increased by 0.26" wc with the Channel Blender® in operation.

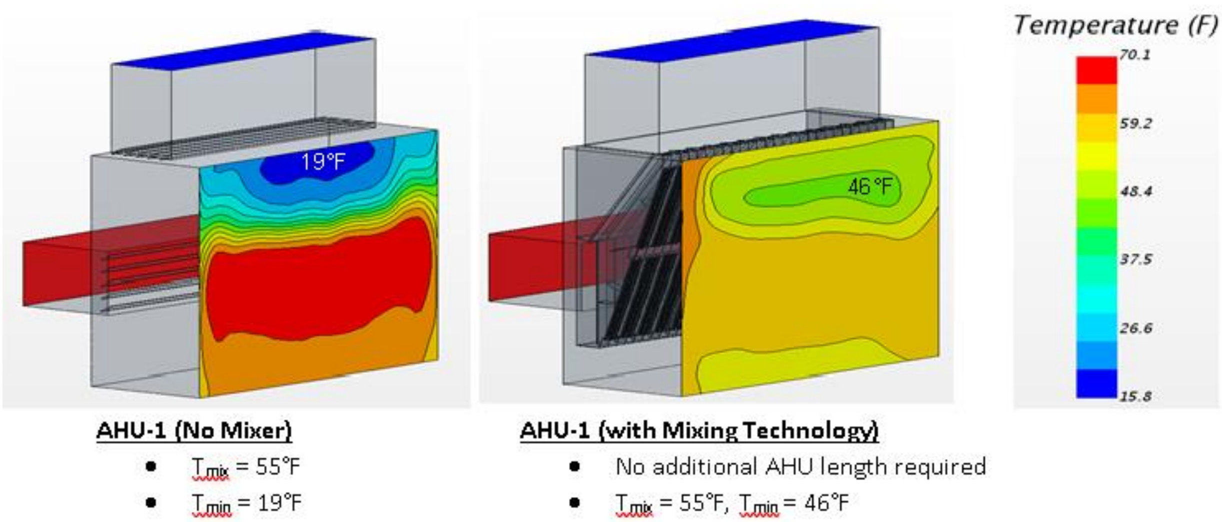
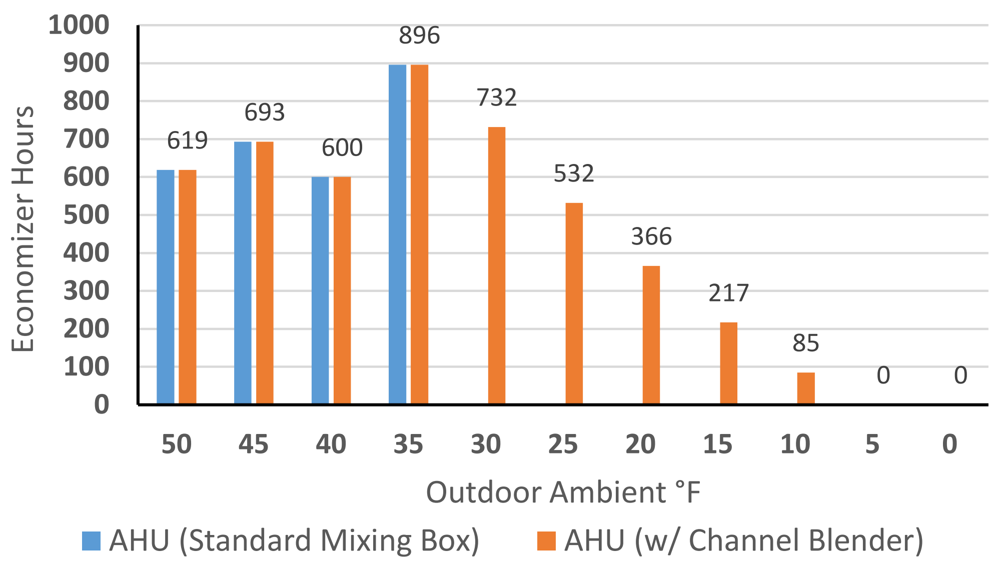


Figure 2. Comparison of Mixing Performance inside AHU (SA = 44,000 CFM, OA = 25%)

Using ASHRAE BIN data for Denver, CO an energy analysis was performed to quantify the number of extended economizing hours the Channel Blender® would provide due to the increased mixing and raising the minimum temperature above a freeze stat threshold. For the mixing box shown above in Figure 2, this retrofit provides an estimated 1,932 hours of extended economizing hours annually as shown below in **Figure 3**. **Extending economizer operations when the OA temperatures range between 10°F - 30°F results in significant energy savings**. When considering the equipment cost of the Channel Blender® relative to the energy savings potential, **simple payback for the equipment installed was approximately ~1.5 years.** This payback duration is based strictly on energy savings and does not consider the additional benefits of eliminating freeze stat trips and removing the risk of rupturing a coil.

The energy savings potential includes the cost savings recognized by eliminating the operation of the chiller and boiler when the OA temperature is below freezing. It also considers the additional fan energy required due to the increased pressure-drop imposed on the system from the Channel Blender® (i.e., 0.26" wc). For this analysis, a blended electrical rate of $0.10/kWh was used. A sensitivity plot showing a range of payback periods for different blended electricity rates is shown in **Figure 4**. Payback periods for different locations (e.g., Minneapolis, New York City) with varying OA design temperatures are also shown.



<u>**Figure 3. Extended Economizer Hours for AHU in Denver, CO due to Increased Mixer Performance (SA = 44,000 CFM, OA = 25%)**</u>

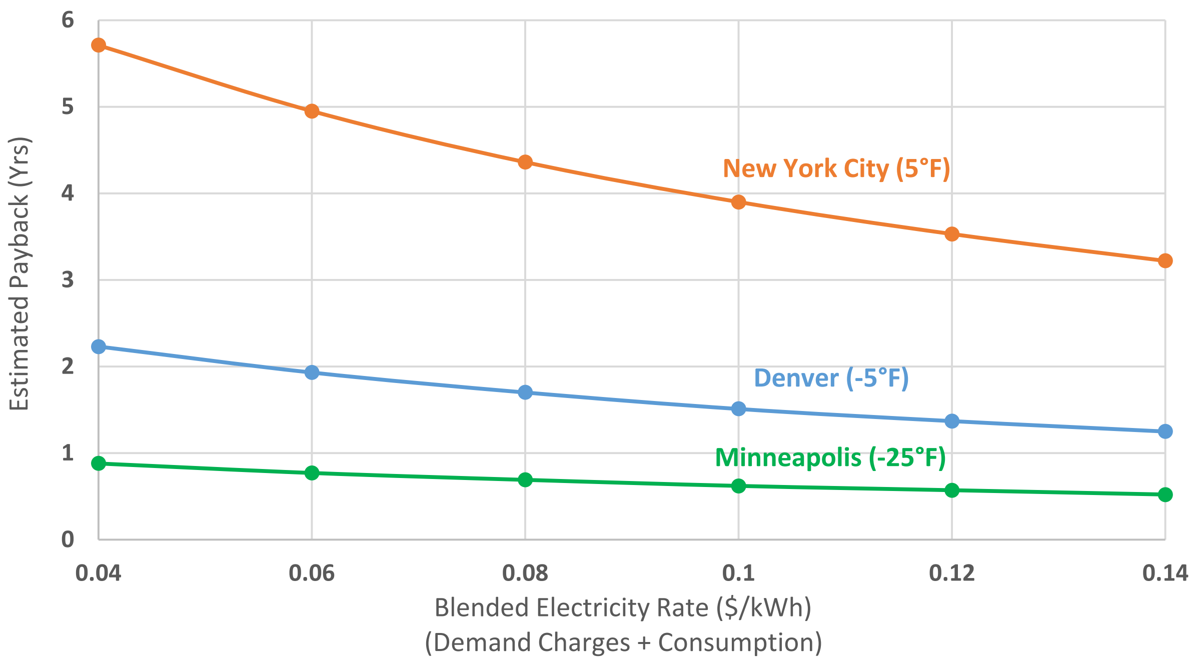


Figure 4. Estimated Payback Periods for Subject Channel Blender®(SA = 44,000 CFM, OA = 25%)

Conclusion:

Adhering to proper ventilation rates in cold weather environments when the outdoor air temperature is below 32°F can be problematic when the OA% is high and poor mixing exists inside the mixing box or economizer section of an AHU. The cold outdoor air can lead to nuisance freeze stat trips and higher operating costs for building operators.

The Channel Blender® significantly reduces the amount of air stratification inside an AHU, which can have a myriad of operational benefits for building owners and operators. It has been our experience over the last couple years (2019 – 2020), increasing the economizing duration of an AHU can provide significant energy savings to building operators. Payback periods for a Channel Blender are project specific, and can vary based on number factors: ventilation rates, energy costs, and design conditions.