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Air to Air energy exchangers

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Abstract: This research work deals with the implication of modern retailing at not only in Dhaka, Bangladesh but also the whole district in Bangladesh with main objectives to find out technological activity, impact on modern welfare..

Key words:- *Membrane, Cell ,Filter section, Resistance, Heat*

I. INTRODUCTION

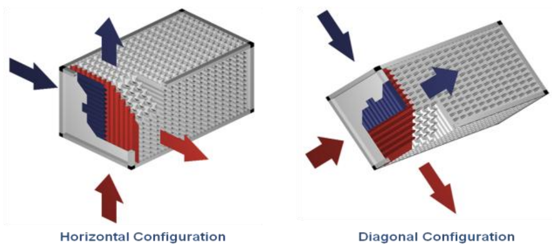
Air-to-air membrane energy exchangers (MEEs) are attracting increasing attention as one of the most important novel trends in heat and energy recovery exchangers for heating, ventilating and air-conditioning (HVAC) systems. In MEEs, simultaneous heat and moisture transfer through the selectively permeable membrane reduces the energy consumed for heating, cooling, dehumidifying or humidifying the ventilation air. In cold climates, the moisture transfer from the warm and humid exhaust airstream to the cold and dry supply air lowers the dew point of the exhaust airstream. Consequently, condensation and frost initiates at lower outdoor air temperatures compared to sensible-only heat exchangers. Frosting may be reduced or even prevented when the exhaust air is sufficiently dried by the moisture recovery in the MEE. However, the metrics of MEEs for avoiding frosting in cold climates are less known and explained in the literature. The main objective of the thesis is to explore the feasibility of the membrane energy exchanger for cold climates with respect to frosting limits, performance of the quasi-counter-flow MEE and to further explain heat and mass transfer processes in MEEs. In order to qualitatively and quantitatively evaluate the frost-tolerant characteristic and the performance of the membrane energy exchanger in cold operating conditions, MEEs and other heat/energy recovery exchangers applied in cold climates are compared. The frosting limit models for the cross-flow and the quasi-counter-flow MEEs were theoretically developed and experimentally verified through this work.

II. HEADINGS

The membrane energy exchanger tends to lower the outdoor air temperatures which initiate onset of frosting, compared to sensible-only heat exchangers. Both thermal and hydraulic performance of the quasi-counter-flow MEE under cold operating conditions were investigated. The quasi-counter-flow arrangement is able to provide relatively high sensible and latent effectivenesses. This flow arrangement may be an ideal alternative to the widely-used cross-flow exchangers. The heat and mass transfer in the MEE are more complex and boundary conditions may be different from sensible-only heat exchangers. However, most classic knowledge and data of heat exchangers tend to be applicable to MEEs under some conditions.

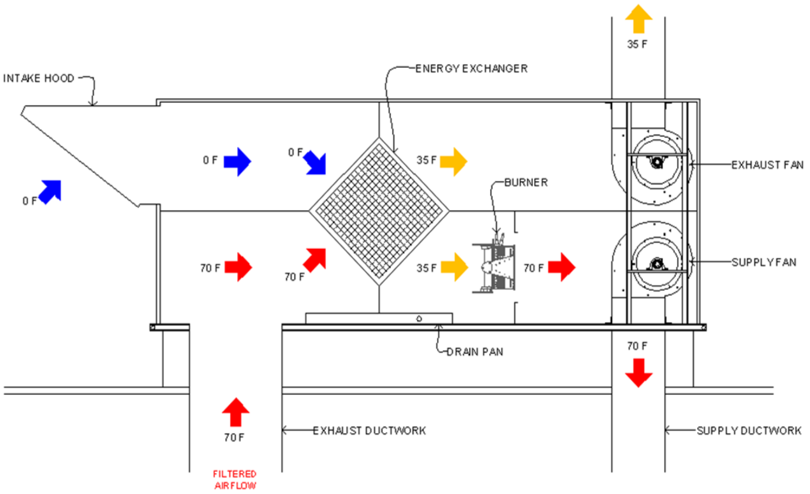
III. INDENTATIONS AND EQUATIONS

An Air to Air Heat Exchanger utilizes the heat in an exhaust ventilation process to pre heat make-up air to reduce the required heat load of the system. Separate aluminum plates are placed into a casing at opposing directions to create separate airflow chambers. The exchanger is placed into a make-up air handler to capture the heat from the exhaust air and transfer it to the supply air.There are multiple configurations that can be used for new applications or to retrofit an existing system. Some of these include horizontal and diagonal configurations.



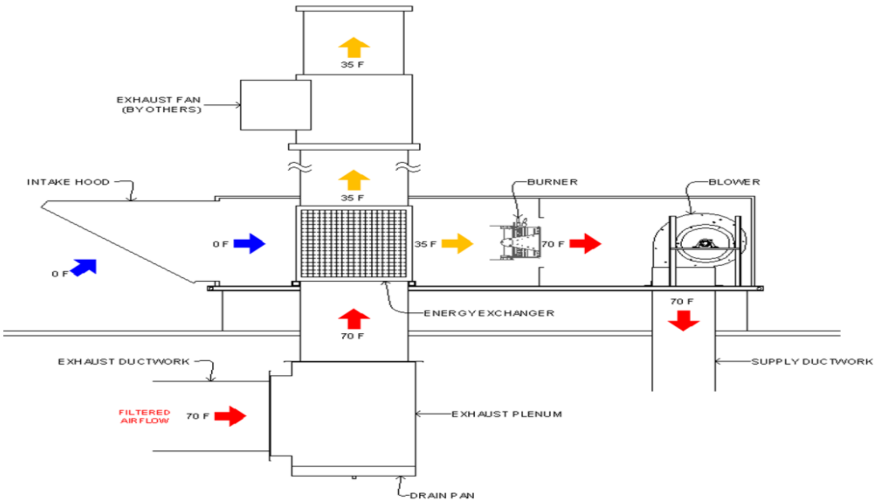
IV. DIAGONAL CELL INSTALLATION

The energy recovery make-up air unit uses the work space exhaust to pre-heat the outdoor air using the energy exchanger. The work space exhausted heat is transferred into the energy exchanger. The energy exchanger then transfers the heat into the outdoor air stream. In the application example below, the 0 degree F outdoor air warms up to 35 degrees F requiring less BTU to heat up to the desired 70 degrees F for the work space.
The energy exchanger in the diagonal configuration can have the exhaust come in the bottom or side of the unit. This is a true packaged style make-up air unit with all components in one casing. This style can be used where space is limited above a paint booth.



V. HORIZONTAL CELL INSTALLATION

The energy recovery make-up air unit uses the work space exhaust to pre heat the outdoor air using the energy exchanger. The work space exhausted heat is transferred into the energy exchanger. The energy exchanger then transfers the heat into the outdoor air stream. In the application example below, the 0 degree F outdoor air warms up to 35 degrees F requiring less BTU to heat up the desired 70 degrees F for the paint booth.
The energy exchanger in the horizontal configuration must have the exhaust come in the bottom of the unit under the roof. This requires a return air plenum that includes a drain pan to catch any condensation. A filter section must also be upstream of the energy exchanger.



VI. FACE & BYPASS FROST CONTROL

The energy exchanger can frost or ice up if the outdoor air is too cold. A face and bypass damper is added to the units to protect the energy exchanger. A thermostat bulb is mounted down stream of the exchanger to measure the airflow temperature. This sensor detects if the exchangers cold corner is getting close to the freezing point. if the temperature falls below the set point the face and bypass dampers modulate to decrease outdoor airflow across the exchanger. The bypass damper allows the air to bypass the exchanger. The exhaust airflow remain the same which raises the temperature of the energy exchanger.Figure 1 shows the unit in a satisfied mode where the face damper is 100% open and the bypass damper is 100% closed. All the outside air passes through the energy exchanger. The exhaust air flow is constant. The dampers will modulate to maintain the factory set 34 degrees F using the proportionate temperature controller.Figure 2 shows the unit in a frost protection mode where the face damper is partially closed and the bypass damper is partially open. Some of the outdoor air now bypasses the exchanger and the exchanger temperature rises because of the reduced supply airflow and constant hot exhaust air. The dampers will modulate to maintain the factory set 34 degrees F using the proportionate temperature controller.

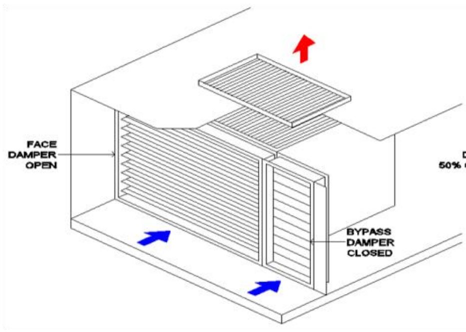


Figure-1

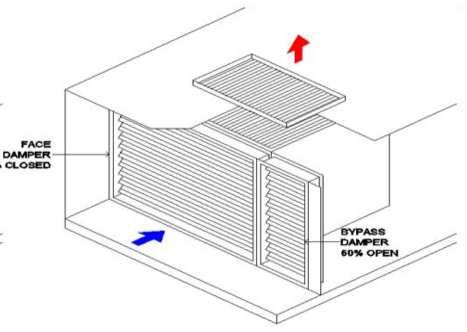
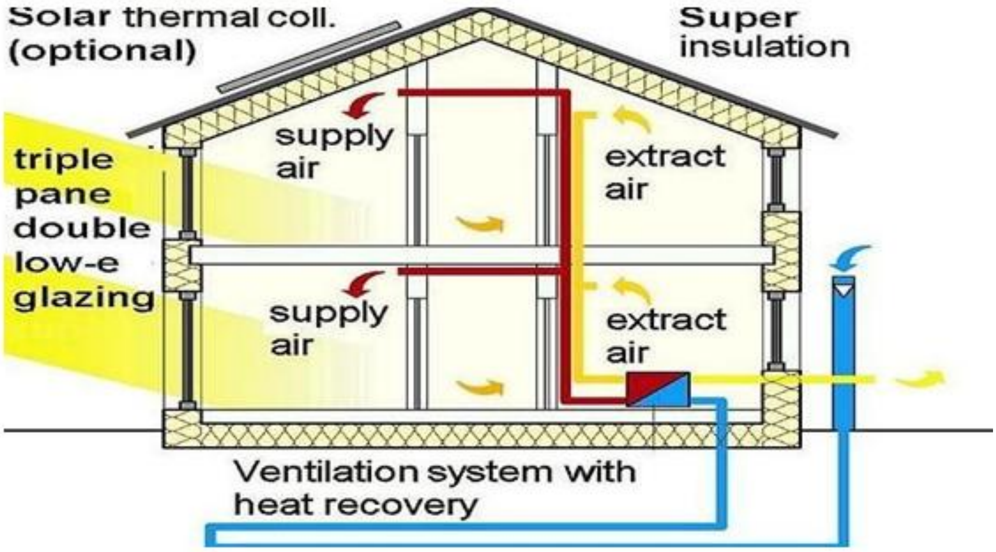


Figure-2

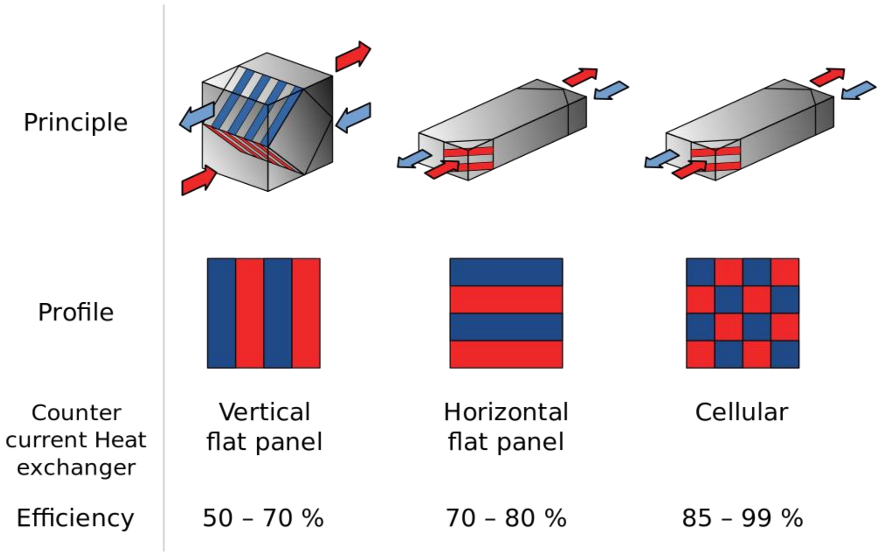
Global Finishing Solutions | Osseo Wisconsin | Retrofit Example

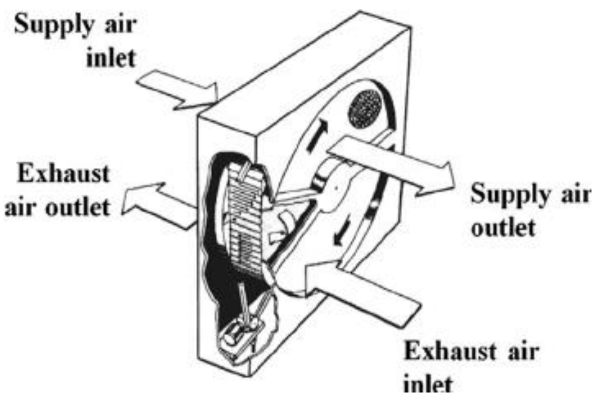
Titan Air and Global Finishing Solutions collaborated on project to add direct fired energy recover units to Global Finishing's paint shop. The project went great and accomplished the goals of reducing fuel costs and balancing building pressurization.Pre Retrofit: The building had 3 exhaust fans running at 16,000, 16,000, and 25,000 CFM and one 60,000 CFM make-up air unit. The 70 degrees F exhaust heat was not being recovered and the make-up air was running at a constant volume. This causes the building to waste fuel and have pressure swings as the paint booths were being turned on and off.Retrofit: The exhaust fans were retrofit with new make-up air unit and energy exchangers. The exhaust was routed through the exchanger recovering the heat to preheat the supply air. The make-up air units were interlocked with the booths to only run while the booth was being used. There was a 10,000 CFM 80/20 recirculating make-up air unit added to the building that modulated the outside to return air mixture to pressurize the building.Conclusion: The average fuel costs have been reduced by 55% per winter, and the building is now running at a positive pressure without pressure swings.

An energy exchanger comprising: a housing; a plurality of panels forming desiccant channels and air channels extending through the housing, the air channels configured to direct an air stream through the housing; a desiccant inlet in flow communication with the desiccant channels; a desiccant outlet in flow communication with the desiccant channels, the desiccant channels configured to channel desiccant from the desiccant inlet to the desiccant outlet in at least one of a counter-flow or cross-flow direction with respect to the direction of the air stream; and a semi-permeable membrane extending through each panel to facilitate heat and water vapor transfer between the desiccant in the desiccant channels and the air stream in the air channels, the air stream and the desiccant causing the semi-permeable membrane to deflect during operation, the desiccant membrane selected based on predetermined channel deflection ranges that are defined to limit the amount of membrane deflection. The energy exchanger of claim wherein a standard deviation of a hydraulic diameter of all of the air channels and desiccant channels divided by a mean value of a hydraulic diameter for one of the air channels or desiccant channels is within a range 0.0 to 0.2. The energy exchanger of claim 25, wherein a standard deviation of a hydraulic diameter for one air channel or desiccant channel divided by a mean hydraulic diameter for the air channel or desiccant channel is within the range 0.0 to 0.2. The energy exchanger of claim 25 further comprising: an air channel support screen having a solid area that is a fraction of a total area of the air channel support screen; and a desiccant channel support screen having a solid area that is a fraction of a total area of the desiccant channel support screen. The energy exchanger of claim 25 further comprising an air channel support screen, a distance between the air channel support screens in the flow direction of the air stream divided by a distance between the air channel support screens normal to flow direction of the air steam is within a range of 0.01 to 5.0.The energy exchanger of claim 25, wherein a desiccant flow direction through the desiccant channels is controlled so that lower density desiccant flows separately from higher density desiccant. The energy exchanger of claim wherein an angle between a normal vector to a plane of each air channel and desiccant channel and an acceleration of gravity vector is within a range of 45° to 135°. The energy exchanger of claim 25, wherein an angle between a vector parallel to a length of each panel and a vector direction of gravitational acceleration is within a range of 60° to 120°.



An energy exchanger comprising: a housing; a plurality of panels forming desiccant channels and air channels extending through the housing, the air channels configured to direct an air stream through the housing; a desiccant inlet in flow communication with the desiccant channels; a desiccant outlet in flow communication with the desiccant channels, the desiccant channels configured to channel desiccant from the desiccant inlet to the desiccant outlet in at least one of a counter-flow or cross-flow direction with respect to the direction of the air stream to facilitate heat and water vapor transfer between the desiccant in the desiccant channels and the air stream in the air channels, wherein the desiccant is selected based on predetermined salt solution concentration ranges for a selected life span and cost of the desiccant. The energy exchanger of claim wherein the time duration for a risk of crystallization in the desiccant flow channels over a year divided by a total yearly time of energy exchanger operation is less than 0.15. The energy exchanger of claim wherein the cost of the desiccant divided by the cost of a lithium chloride solution is less than 1.





An energy exchanger comprising: a housing; a plurality of panels forming desiccant channels extending through the housing; air channels formed between adjacent desiccant channels, the air channels configured to direct an air stream through the housing; a desiccant inlet in flow communication with the desiccant channels; and a desiccant outlet in flow communication with the desiccant channels, the desiccant channels configured to channel desiccant from the desiccant inlet to the desiccant outlet so that the semi-permeable membranes facilitate heat exchange between the desiccant and the air stream, wherein the energy exchanger operates within predetermined exchanger performance ratios that define a thermal and latent energy exchange between the desiccant and the air stream. The energy exchanger of claim wherein an exchanger number of transfer units with the energy exchanger is within a range of 1 to 15. The energy exchanger of claim 45, wherein an exchanger thermal capacity rate ratio within the exchanger is within a range of 1 to 10. A method of exchanging energy between a desiccant and an air stream, the method comprising: extending a plurality of panels through a housing of the energy exchanger to form desiccant channels and air channels; selecting a semi-permeable membrane for each of the panels; directing an air stream at a predetermined air mass flow ratio through the air channels; and directing desiccant through the desiccant channels, wherein the semi-permeable membrane is selected based on membrane resistance ranges defined to limit a flow of the desiccant through the desiccant membrane, the air flow ratio of the air stream is selected to meet a predetermined exposure of the air stream to the desiccant membrane, and a flow rate of the desiccant with respect to a flow rate of the air stream is controlled to achieve predetermined exchanger performance ratios that define a thermal energy exchange between the desiccant and the air stream. The method of claim wherein an exchanger thermal capacity rate ratio of the energy exchanger is within a range of 1 to 10. The energy exchanger of claim 48, wherein an exchanger number of transfer units with the energy exchanger is within a range of 1 to 15. The energy exchanger of claim 48, wherein the membrane has a water vapor diffusion resistance and a convective water vapor mass transfer resistance in the air channel, a ratio of the membrane water vapor diffusion resistance divided by the convective water vapor mass transfer resistance of the membrane is within a range of 0.2 to 3. The energy exchanger of claim 48, wherein the membrane has a membrane liquid break-through pressure defined as the pressure required for desiccant to flow through the membrane, a ratio of the membrane liquid break-through pressure divided by (rho*g*H), wherein rho is the density of the desiccant, g is gravity and H is a height of the membrane, is greater than 20. The energy exchanger of claim 48, wherein the membrane has an edge seal liquid break-through pressure defined as the pressure required for desiccant to flow through an edge seal of the membrane, a ratio of the edge seal liquid break-through pressure divided by (rho*g*H), wherein rho is the density of the desiccant, g is gravity and H is a height of the membrane, is greater than 20. The energy exchanger of claim 48, wherein the membrane includes a screen having wires, the wires having a spacing (s_{ws}), the desiccant having an operating pressure ($pi,_{op}$), and the membrane having a tensile yield limit ($T_{m>}yi$), a ratio of $T_{m>}yi/(P\iota,o\rho^* s_{ws})$ is less than 1.5. The energy exchanger of claim 48, wherein the air flow resistance ratio is defined as (p A_c/V_c), wherein p is a pressure drop of the air stream across the energy exchanger, A_c is an area of an air channel, and V_c is a volume of the air channel, wherein the air flow resistance ratio is between 10^3 and 10^4. The method of claim 48 further comprising controlling the mass flow rate of the desiccant with respect to the mass flow rate of the air stream based on a temperature and humidity ratio of the air stream. The method of claim 48 further comprising controlling the mass flow rate of the desiccant so that the thermal capacity rate ratio of the desiccant is no more than 5 times the thermal capacity rate ratio of the air stream. A method of exchanging energy between a desiccant and an air stream, the method comprising: extending a plurality of panels through a housing of the energy exchanger; spacing the plurality of panels based on predetermined air to desiccant channel rates to form desiccant channels and air channels between adjacent panels, the predetermined air to desiccant channel rates defining an air channel width and a desiccant channel width; selecting a semi-permeable membrane to extend through the panels based on predetermined channel deflection ranges that are defined to limit an amount of membrane deflection; directing an air stream through the air channels; and directing desiccant flow through the desiccant channels in at least one of a counter-flow or cross-flow direction with respect to the direction of the air stream so that the membrane facilitates heat and water vapor exchange between the desiccant in the desiccant channels and the air stream in the air channels, the predetermined air to desiccant channel rates to providing a predetermined volume rate of air stream flowing through the air channels and a predetermined volume rate of desiccant flowing through the desiccant channels. The method of claim further comprising constructing the housing and energy exchange panels so that a height of the heat and water vapor exchange area in each channel divided by a length of the exchange area is within a range of 0.5 to 2. The method of claim wherein the desiccant channel width is nearly constant through the housing and the air channel width is substantially constant through the housing. The method of claim, wherein a ratio of the average air channel width divided by the average desiccant channel width is within a range of 1 to 5. The method of claim further comprising: providing a desiccant inlet in fluid communication with the desiccant channels; providing a desiccant outlet in fluid communication with the desiccant channels; and offsetting the desiccant inlet from the desiccant outlet along a direction of the air stream. The method of claim further comprising directing the desiccant along a flow path having a cross segment and a counter segment, the cross segment extending in a direction substantially perpendicular to a direction of the air stream, the counter segment extending in a direction substantially parallel to a direction of the air stream. The method of claim further comprising directing the desiccant along a flow path in a direction upstream with respect to a direction of the air stream. The method of claim further comprising controlling a flow rate of the desiccant with respect to a flow rate of the air stream to achieve predetermined exchanger performance ratios that define a thermal energy exchange between the desiccant and the air stream.

VII. CONCLUSION

Limitation:

1. Air and air energy place must be remain in room temperature.
2. Sometimes it is difficult to find out air flow direction appropriate.

Though it has limitations but modern era is very dependable on these. Specially in pharmaceutical sector these are very effective. Hence, all kinds safety for human is possible by this system. So, this system is absolutely welcome for modern era.