IMPORTANT DESIGN FEATURES OF HEAT EXCHANGE SYSTEMS FOR NEW ZEALAND HOMES.

There are a number of heat exchange systems currently available in New Zealand however there are significant differences in terms of efficiency, system design and quality that consumers need to be aware of and take into account when evaluating heat recovery style home ventilation systems. Condensation Control Ltd, one of the leading manufacturers of home ventilation systems in New Zealand for over 10 years has recently introduced the moistureMASTER^{tm} HX heat exchange system and this has been exclusively built in Germany and designed specifically for New Zealand conditions. It is packed full of design features which are not only innovative but extremely important in delivering the highest performance for the most economical outlay.

In new, well insulated homes, heat exchange systems are the most energy efficient way of delivering fresh air but there are a number of key features in their design which are extremely important in the context of the New Zealand climate and the way in which New Zealander's heat their homes. The purpose of this document is to draw these features to your attention and discuss the implications and importance of correct system design. The exact nature and delivery of energy efficiency improvements is very much dependent on design and correct installation.

The moistureMASTER^{tm} HX system is designed to ensure that in both cases maximum performance in terms of efficiency, best practice and home comfort are achieved.

We believe you will be impressed with the extent of the moistureMASTER^{tm} HX system and the sensible and practical features we have incorporated in its design. We believe that the design and performance of the HX system is unmatched anywhere in the world. We have used our homegrown experience and innovation in home ventilation, the very latest technologies available world wide and the design competence of our engineering colleagues in Germany. We invite you to accurately compare our system with all other systems currently available in New Zealand.

Heat Recovery Systems

Heat recovery ventilation recovers and transfers heat between airstreams. They are better for moisture removal as moisture is not transferred between the exhaust and the incoming air. The core of the air to air heat exchanger is typically plastic or aluminium.

Energy Recovery Systems

Energy recovery ventilation recovers and transfers heat and moisture. The core is a specially treated permeable material that can absorb moisture as well as heat. Given the naturally high humidity of this country, energy recovery systems are not generally recommended for New Zealand conditions. They are more suitable for ventilating spaces with artificially low humidity or in geographical areas where humidity is naturally low. *[1]

The Lossnay "Energy Recovery" exchange system marketed by Mitsubishi here in New Zealand utilises a paper based or permeable exchange plate and its suitability to the new Zealand market must be seriously questioned.

EXCHANGE PLATE CONSTRUCTION

Exchange plates are generally constructed from aluminium, plastic or as previously mentioned of permeable materials. Great attention should be made to this aspect as it will ultimately determine the efficiency, effectiveness and the life of the entire heat or energy recovery process. The old saying that you *"pay for what you get"* is no less true in the design, construction and production of exchange plates.

Permeable membrane exchange plates are not considered suitable for New Zealand climatic conditions for the reasons as previously stated and there are serious question marks in regards to the contamination over all materials that absorb moisture in air conditioning, air movement and ventilation systems.

Plastic heat exchangers also have their problems. Static electricity generated by air moving through the plastic cells of the heat exchange plates causes a gradual build up of contaminated particles. This is recognised as a major problem in the use of plastic heat exchange plates. This contamination is likely to result in bacteria and mould formation on the plate surface.

High air pressure levels through the plastic cells of "counter cross flow" heat exchange systems may cause twisting and fracturing of the plastic cells. Minor failure of the plates may go undetected for some time until the efficiency drops to a level which is clearly noticeable.

The deterioration process that is problematic of all plastic heat exchange plates significantly limits the life of the heat exchange system itself. Because of these unresolved, but related problems, there is a definite movement in the European market away from plastic exchange plates back to aluminium.

Aluminium plate exchangers, on the other hand, are better in every area of consideration. They are long lasting and do not have the hygiene issues as the

*[1] BRANZ (Building Research Association of New Zealand) Bulletin 508 Heat/Energy recovery ventilation systems page 5.2

other types and are more sensitive to temperature change. They have a higher all round performance and their efficiency in heat recovery is also regarded as superior. The aluminium plate exchanger also allows for the exhausting from "wetter" areas of the home such as bathrooms, laundries and kitchen.

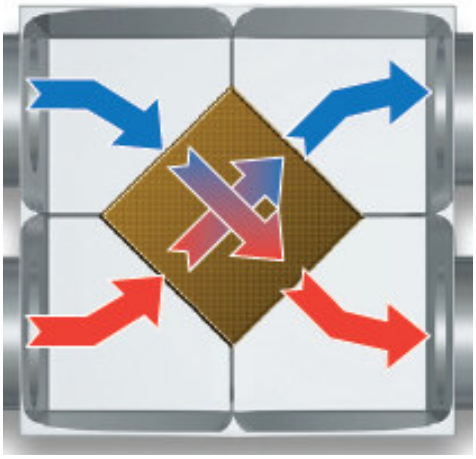
Maintenance and Cleaning
Regular maintenance of heat exchange plates also cannot be ignored. Aluminium plates require minimal attention. Plastic heat exchange plates on the other hand are a different matter. Cleaning of the plastic plates are recommended in BRANZ Bulletin section 508 at 6 or 12 monthly interval.
It seems that the reasons for the move towards plastic exchange plates are now heavily outweighed by their deficiencies. The advantage of price is severely exceeded by the apparent weaknesses.

TYPES OF EXCHANGE PLATES

There are two main types of plate heat exchange systems. Cross flow exchangers and "counter" cross flow systems.

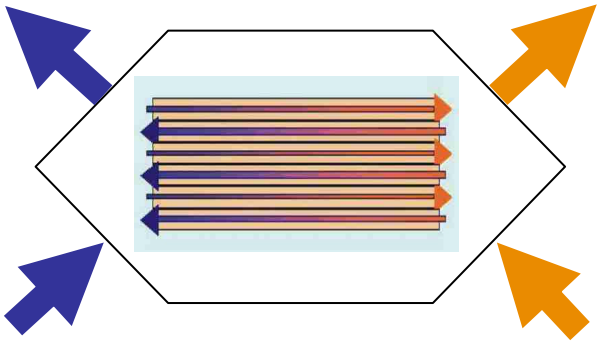
Cross Flow Heat Recovery Explained:
The cold and warm air, flow at a right (90 degrees) angle to each other. Due to this a cross flow heat exchanger is of quadratic shape. A Cross Flow heat exchanger has one advantage: The heat exchanger is easier to manufacture and thus cheaper. The main disadvantage is the physical efficiency limitation. It is difficult to obtain 50% efficiency. Two or more cross flow heat exchangers in series are needed to improve the efficiency to 75%.

The diagram shows the difference between the two types of plate exchangers



Cross flow 50 to 60% efficiency

Counter Cross Flow Heat Recovery Explained:
As the cold air travels towards the warm end of the system, the warm air travels towards the cold end of the system. The cold air will become progressively warmer whereas the warm air will become progressively cooler as the heat (energy) is exchanged. If the system is sufficiently long, the entire heat will be exchanged = 100% efficiency.
The fresh, cold air will be heated to the temperature of the warm, stale air before it reaches the warm side of the system. At the same time the warm stale air is cooled to the temperature of the cold, fresh air, before it leaves the system. The difference in efficiency in heat recovery is significant. There is a much more uniform transference of heat throughout the exchange unit.



Counter cross flow 90% efficiency

*The moistureMASTER^{tm} HX heat recovery system utilises a highly efficient aluminium **counter cross flow plate** exchanger which generates the highest efficiencies available from a heat exchange system.*

The moistureMASTER^{tm} HX system utilises an aluminium plate exchanger which has been the industry standard for years. The model included in the HX is manufactured in Germany and is one that is widely used in high quality, high efficiency air handlers for the European commercial market. The metal exchangers will last a life time and have enabled Condensation Control to integrate a supplementary heater within the heat exchange unit. This is not possible with systems constructed with plastic bodies or plastic exchange plates.
The moistureMASTER^{tm} HX system includes a condensation drain to drain any condensation which forms inside the unit due to warm wet air meeting the colder fresh air cells in the heat exchange process. Most systems on the New Zealand market do not include condensation drains or are constructed from material that is permeable and cannot be used for extracting from the wetter areas.i.e. bathrooms

HEAT REDISTRIBUTION OR HEAT TRANSFER

Heat recovery systems are more efficient if all the air being ventilated from a home exits the home through the heat exchange system. Systems that exhaust from the home without including air from independent extract systems are less efficient. However if heat distribution from a large heat source in the living room is the goal then it may not be advisable to include exhaust vents from colder bathrooms. A better solution may be Forced Air Ventilation with a system that includes a well designed "Heat Transfer" option. The exception to this is in centrally heated homes where there is an even distribution of heat throughout the home.

FANS

Apart from the heat exchange unit the efficiency and capability of the air movement devices in the system is also very importance. Most domestic heat exchange systems are designed with the fans incorporated within the unit. This increases the overall size of the heat exchange console which can severely restrict installation options. Incorporating the fans within the body of the unit also limits the size of the fans which are able to be used. Because of the size restrictions the most commonly used fans employ "forward curved" rotors which are on the lower end of the efficiency curve in fan technology.

Some heat exchange systems are now being designed with the fans mounted externally and this has significant advantages both in system design and layout.

Externally mounted fans are also a significant advantage in the installation process. It is imperative that all duct runs are installed without sharp bends. With the complexity of many installations and the fixed orientation of the inlet and outlet spigots of heat exchange systems this is almost impossible to achieve in some roof cavities. Externally mounted fans can be installed away from the exchange unit and sharp bends and the quick change of direction in duct runs are more easily avoided. Another major advantage of the fans being mounted externally as that a variety of fans may be selected and optimised for application required. Many proprietary heat exchange units with internally mounted fans have a very narrow range of suitability. The section on "summer by-pass" also highlights another major advantage of externally mounted fans.

The easy access to externally mounted fans also presents a major advantage when the servicing of the fan is necessary.

The moistureMASTER^{tm} HX system is designed to take particular advantage of all these design features and is able to accommodate new fan technology as it becomes available. Recent German innovation incorporates a new and revolutionary redesign in fan rotor technology which has inspired a completely new range of fans. The Etaline fans from Ruck Ventilatoren includes the new technology and are exclusively available to Condensation Control Ltd to incorporate in the new HX system. The Etaline fans are extremely quiet and this is a necessary pre-requisite for any external mounted fans. This factor alone has enabled Condensation Control Ltd to achieve design flexibilities that were otherwise not possible.

FILTER AND AIR CLEANING

Filter and air cleaning is a very important consideration in some areas of New Zealand, which are prone to pollens, traffic pollution and smog. Whilst particle filters may go a long way to removing harmful particles from entering the home, air filtration in a heat exchange system poses its own set of difficulties. The pressure drop attributed to the exchange plate, particularly the counter cross flow systems, means that any significant pressure loss due to higher grade filters often renders them as unsuitable for this application. Some method of cleaning the air more effectively may be necessary..

The moistureMASTER^{tm} HX system incorporates its own patented filtration system. The filters are mounted externally in a cassette and the cassette is able to accept a range of particle and carbon activated filters. The cassettes are constructed in a way to allow consumers to replace filters very easily themselves. The electronic controller even informs the homeowner when the filter is due to be changed. The moistureMASTER^{tm} HX system also has an optional electronic air cleaner utilising Ozone and UV to deodorise and clean the system. This prevents any build up or contamination from taking hold in the heat exchange element plates and is the only way of ensuring continuous clean healthy air.

*Filters arrest particles but cannot prevent mould or bacterial growth. The **"Pure Air"** module which is proprietary to the moistureMASTER^{tm} HX system alters the molecular structure of contaminated air particles and does what filters cannot do.*

SUMMER BYPASS

In the summer time the heat exchange system works in reverse. In an air conditioned home the indoor air will be cooler and the exchange unit will cool the warmer outside air before it is introduced. However the bulk of New Zealand homes are not air conditioned, therefore the warmer indoor air will actually heat the incoming fresh air significantly as it passes through the heat exchange unit. This makes summer time use of heat recovery often unsuitable.

Some systems allow for the fresh outside air to bypass the exchange plate in the summer time and enter the home without picking up any heat as it passes through the system. These units are fitted with an "internal" bypass. Unfortunately "internal" bypass systems have major limitations in the New Zealand context and have proven to be inadequate in allowing for significantly

increased airflows. In order to provide "adequate" summer cooling by ventilation a substantially higher volume of air is necessary. This means that a system must be capable of handling a substantially higher quantity of air and generally it takes a larger fan to deliver the airflows that will produce worthwhile and acceptable results. "External" summer bypasses are the answer as long as the fans in the system are large enough to handle a significantly higher volume of air. Most heat exchange units on the New Zealand market have major draw backs in three areas. They do not include a summer bypass option, the summer bypass option is of the internal design or the fans, whilst large enough for winter time heat recovery, are not large enough to provide an air volume that makes the summer operation worthwhile without air conditioning.

The moistureMASTER[tm] HX system addresses all three important parameters. Not only is the bypass external but larger fans and larger diameter duct can be used to ensure that air flow is maximised and will deliver superior performances in the summer time.

BUILT-IN SUPPLIMENTARY HEATER

Heat recovery systems rely primarily on taking warmth from indoor air and passing it through the heat exchange unit to warm the cooler fresh air before it is introduced into the home. In climates where central heating is necessary for adequate winter warming and a constant supply of heated indoor air is available heat recovery systems work best.

However it is clear that in the more temperate New Zealand climate where homes cool significantly between the hours of midnight and dawn sufficient indoor heat is often not available to adequately warm the fresh cold night time air. This is a major problem with any heat recovery system here in New Zealand and is even more so with the less efficient cross flow heat exchange systems which are only capable of recovering up to 60% of the available heat.

The moistureMASTER[tm] HX is the only system which includes an integrated in-built supplementary heater (1500W) on the supply side of the system. This ensures that air is able to be delivered at a pre-selected temperature irrespective of climatic conditions and the heat within the home. (There are limitations to this in very poorly heated homes). With our vast experience in ventilation, in particular, heated home ventilation systems, we believe that many consumers will view this as an essential feature. The HX system is also able to accommodate an externally mounted heat booster to achieve a maximum output of 3.0 KW's if required.

WARM ROOF CAVITY EXHAUSTING

One of the major benefits of positive pressure in-put ventilation systems sourcing the air from the warmer roof cavity is the significant heat recovery which is obtainable on sunny days. Heat exchange units, however, normally source the fresh air directly from outside instead of the roof cavity. Some roof cavity air may be unsuitable to introduce into the home and there is a perception that roof cavity air is not as fresh as outside air. The New Zealand Building Code is very clear in its definition of ventilation and the requirement to take the air directly from outside.

The moistureMASTER[tm] HX system incorporates a simple damper device which allows the warmer roof cavity air to be picked up during the daytime and exhausted through the heat exchange unit. The warmth is recovered and pushed into the home whilst the air itself is exhausted to the outside. To increase the energy efficiency of heating our homes during the day time, this is a major consumer advantage. Other heat recovery systems are not fitted with this feature and therefore miss out on this additional free heat "energy boost".

SIZE

In the moistureMASTER[tm] HX system the fans and filters are mounted externally and this significantly reduces the size of the system. At 800mm in length, 410mm wide and 357mm high this is the most compact unit available. Not-withstanding this compactness the HX system is capable of handling an impressive 850 cubic meters of air per hour. This is generally adequate to ventilate homes up to around 250 square meters of living space. The compact design of the HX system also means that many existing homes with smaller access to the roof cavity are able to be accommodated.

INSTALLATION

There are many aspects about heat exchange systems that will enhance or degrade its performance in delivering energy efficiency. One which is often forgotten, but nevertheless one of the most important, is that of installation.

With the complexity of many installations and the fixed orientation of the inlet and outlet spigots of heat exchange systems "efficient installation" is hard to achieve in some roof cavities. Unfortunately, most of the important considerations around good, efficient and high quality installation have largely been ignored in the design of many heat exchange systems.

However, the important design features that have been discussed in this document have all been incorporated in the moistureMASTER[tm] HX system. Externally mounted fans, external summer bypass and other flexible design features have not only enhanced the performance of the system but ensures that best practice and a maximum level of energy efficiency should be achieved.