Date: 15th August 2011

Customer: DBK Technitherm Ltd

Reference: Drymatic System

Report author: Chris R Netherton

Goal: To produce a report based on actual drying conditions in the National Flood School's dedicated Flood house using the Drymatic System manufactured by DBK.

History: The National Flood School has been teaching and researching Flood damage subjects since 1988.

In 2001, the founder, Chris R Netherton designed and built a facility based on a disused Surrey County Council classroom. The three part portable building was raised on to an above ground swimming pool construction which doubles as a basement. The inside of the basement is tanked; the principle being that water placed in the basement can be measured and pumped to individual rooms which are constructed of sixty different building materials. The design incorporates a raised platform which serves to have an exposed crawl space where research is carried out to examine the effect of standing and draining water on a flooded building. Once flooded, the building is used to test drying equipment in actual flood conditions at various times of the year, and data is logged to see how the drying techniques used, affect the building. Data is then collated and the measurements taken allow the test authority to monitor when the building has been restored to its 'original' dry state.

Many types of drying equipment are put forward by manufacturers for testing which has served to create a best-tested list (for dehumidifiers), based on various factors such as performance, price, amp draw, hour clocks, humidity sensors, etc. This led to the creation of the classes of dehumidifier.

In general the collection rates of the machines provide the basis of these classes. This also includes the range of temperatures in which efficient collection rates occur. Classes are based on flood conditions during a typical 'dry-down' on the IICRC Applied Structural Drying class (ASD). Typically, it takes approximately 4-5 days to complete the drying process of all of the sixty types of building materials placed in the flood house. When the research started, twenty-three models of refrigerant dehumidifiers were tested, these included high end pre-cooled types known as Low-grain refrigerants which typically glean more moisture in the first drying phase. During the draw-in cycle this technology increases the relative humidity by pre-cooling the air as it enters the dehumidifier.

However, dehumidifiers represent only one of three categories of drying techniques, which are summarised below.

1. **Refrigerant dehumidifier -** this device draws air in across condensers which exist in an operational temperature anywhere from dew point to freezing. The moisture in the incoming air is condensed into liquid phase (water) which under gravity drops into a collection bucket or pumping system. Additionally the system regularly pumps a hot gas across the condensers to an evaporator which unfreezes any ice that has formed. This is the most popular device, as it's easy to install and reduces the humidity in the air to avoid mould damage and other secondary damage, but rather slow in operation as the cycle to collect water only operates approximately every hour.

   Cons - the machine has to be emptied on a regular basis or it could over flow. Automatic cut outs can be fitted at additional cost to the user, this shuts down the machine until emptied disrupting the drying program until switched back on. These machines produce latent heat and if the temperature rises to 33 Degrees C. the refrigerant process becomes ineffective. If the ambient temperature in the flood affected room is naturally higher than this temperature then the same problem occurs.

   An upgrade to this machine is automatic pump-out which works continuously whilst water is being collected. Recently, technology has been introduced which can increase the machine's affectivity by installing pre-coolers before the first condenser. This can be achieved by three techniques; heat pipes, heat exchangers, or extra evaporators and condensers. The machines are termed LGR which means they collect significant amounts of moisture over the same time period. Costs are also significantly higher.

2. **Desiccants Portable -** these devices use an adsorbent rotor, which collects moisture in to the silica-gelled honey comb and evacuates the moisture to outside the building using heat as its drying technique. This type of equipment requires a little more thought and training to use. Position of the ingress air hose and also the output hose is important to avoid the dew point occurring in the hose in cold temperatures. The great advantage is that modern design is more compact than a refrigerant and it works in a much greater range of temperature. Better grams per kilogram of air depression is achieved and they are often used to dry difficult materials. They can also be vented under floors and difficult to reach areas.

   Cons - sometimes referred to as over drying although little evidence exists to support this. Delicate items such as antiques, musical instruments and hard wood floors are typical examples that may suffer from this syndrome.

3. **Heat** - This covers a large spectrum of technologies from simple localised heat sources through to portable boiler trailer mounted systems drying from the outside using high temperature airflow and heat exchangers.
   3a – **Trailer Mount** - Much quicker than other techniques, control of the drying environment is crucial to successful drying goals being met, with **certain temperature sensitive items,**

including food stuffs and electronic equipment needing to be removed from the area being dried.

Cons - delivery on site can be a challenge, especially in a row of terraced house with no on-site parking. Fuel requires topping up and shrinkage can result from lack of control. Portable heaters placed outside the property can be a health and safety issue as fuels can be tampered with.

3b - Portable heat systems – systems designed to combine controlled heat and air circulation to promote efficient drying, typically powered via electricity. Equipment can be fitted with data-logging and remote monitoring equipment to minimise engineer service calls. Equipment is safe, reliable and can typically be left un-attended for the duration of the drying programme.

The **Drymatic®** is such a device and is the subject of this report.

DBK Drymatic System – Manufacturer's Product Brief:

The Drymatic's unique operation is based upon its evaluation of the humidity and temperature of the room to be dried and then operating in the mode that provides maximum drying effect.
When initially switched on, the machine operates in 're-circulation' mode, taking air from within the room being dried and continually re-heating it until pre-set temperature and humidity levels have been reached. These settings can either be determined by the technician or the default settings of the machine.
It then switches automatically to 'exhaust mode', where powerful internal fans extract the air from the room, replacing it with an equal amount of fresh and pre-heated air from an unaffected area (which is generally indoors) or from outside to ensure an on-going optimised drying environment.
Adding controlled heat to the environment speeds up the drying process by promoting evaporation of moisture from the wet structure and contents. Increasing the ambient temperature reduces the relative humidity and allows the air to take on a higher water vapour content, which is then removed out of the property.
Within limits defined by the user, the Drymatic will monitor and adjust the room's environment, constantly optimising and exchanging the moist air with warm, dry air in a controlled manner to remove odours and ensure a faster, fresher and more efficient drying environment.

Features:

- Simple to use controls allow for quick installation.

- Sensors can be used to specify a drying goal based on a known 'dry' material ensuring that the property is not over-dried or under-dried.
- Clear status information from the on board control panel.
- Automatic kWh metering that does not lose memory in the event of a power failure.
- Additionally, the Data-card automatically logs project progress allowing the technician to interrogate drying performance via the software supplied.
- Infra-Red sensors communicate with the machine and enable the user to track the progress of specific walls/floors/ceilings within a room.
- Easy-to-access filter to allow simple servicing where required.
- Optional On-Board SMS Text Messaging Facility can communicate with a drying technician to notify them of any important events during the job such as the ones below:

    1. Machine powered down
    2. Blocked Filter
    3. Room Dry
    4. Wall Sensor Network Fail (Low Battery etc)

National Flood School Testing and Appraisal

The DBK protocol for testing was followed as far as possible.

The area chosen during the discussion is the one marked "lounge" on the plan. This is located directly over the basement which has three functions.

1. Storage tank for the flood water which is measured by filling the tank to preset lines, in this case it was a total of 250 gallons into an area measuring 3.5 metres by 3.5 metres by 2.4 metres.
2. The basement area is typical of crawl spaces and is used to train students on drying basements and to study the drying of semi tanked basements.
3. It also collects water draining from the lounge floor area above. After pumping out this area the remaining water is extracted using a wet vacuum device to bring the standing water down to approximately 2 mm, this is then blown dry using a turbo fan to evaporate any residue to be air borne, which is vented to the area directly above. This laminar air flow breaks off the cold layer to make the evaporation more efficient. In this case it took about two hours.

To aid in this evaporation the heat supply from the Drymatic was directed under the Lounge floor, via the 150mm Heater Outlet hose, to the basement which demonstrated the Drymatic's ability to dry under floor areas and difficult to reach areas. This moisture eventually went into equilibrium with the air located in the lounge through two man hatches, and the two open-able floor observation ports, which were installed as a health and safety protocol rather than use the open hatches. Sensors were placed in three locations, the base station was in the far right hand corner at

floor level, the inside wall sensors were placed in left and right hand walls which were Thermalite block with two different types of plaster. These sensors give RH at depth, ambient temp at depth and water vapour in gram per cubic metre; to obtain industry standard g/kg of air, simply multiply the data figures by 0.833. This information is then sent via wireless data transfer to a website located at Captiondata.com.

Four additional non-battery thermal hygrometers were placed in the area located:-

1. In basement near hatch wall.
2. Under floor in observation port.
3. On left hand wall at low level
4. Five feet high on far wall near tented opening,

These sensors give an independent measurement from the electronic systems and the results were confirmed to be consistent between the two measurement methods.

A typical comparison between Refrigerant Dehumidifiers was carried out in order to obtain a value assessment. However, as the methodology is different in that in the early phase of heat drying the specific humidity of the air is increased, whereas dehumidifiers reduce the specific humidity, this simple comparison was not possible.

So how could we assess this piece of drying equipment versus the alternative?
We proposed:-

A. To value the typical electrical energy consumption based on kWh usage.
B. The speed of drying (Hourly Usage)
C. Noise
D. Capital cost.
E. Management time, including first inspection, interim, and final inspection.

The flood house has been dried numerous times using industry-standard refrigerants dehumidifiers and air movers.

The electricity costs are detailed below:

One dehumidifier (Class oneLGR) over five days is £20.00
Four Air movers (Size and Spec?) over five days is £35.16
Note: The electrical costs can only be estimated unless a meter is supplied for air movers and dehumidifiers

Total rental cost is approx.

Dehumidifier (Class One LGR) - £100.00 (5 Days)
Four Air movers - £200.00 (5 Days) .

Inspections:

Inspections, delivery, installation and first report - £50.00
Second report - £50.00.
Final inspection using Hygrohood x 2 = £20.00.

Total System Cost is approx.. £475.16

The Drymatic System

The electricity costs are detailed below:

Electrical usage is £5.00 per day. Five days = £25

Total rental cost is approx.

Rental Cost: £150 per week

Remote Sensors: £20 per week (However, this can be avoided by using Drymatic's own remote sensing system)

Inspections:

Inspections, delivery, installation and first report - £50.00

Final inspection and report - £50

Note: Management time is drastically reduced via the remote sensors which will allow the machine to send SMS text updates to the drying technician.

Total System Cost is approx. £295

C**apital cost is £3,200 (based on individual purchase) plus 500.00 for optional SMS system.**

Report synopsis:-

The costs are approximate figures and are relative to a test conducted in flood conditions with expert monitoring, and data collection, during both cases optimum drying is aimed for and achieved. The use of a constant building and repetitive testing, guarantees that data can be analysed on a like for like basis – external conditions are factored into testing to ensure fair results.

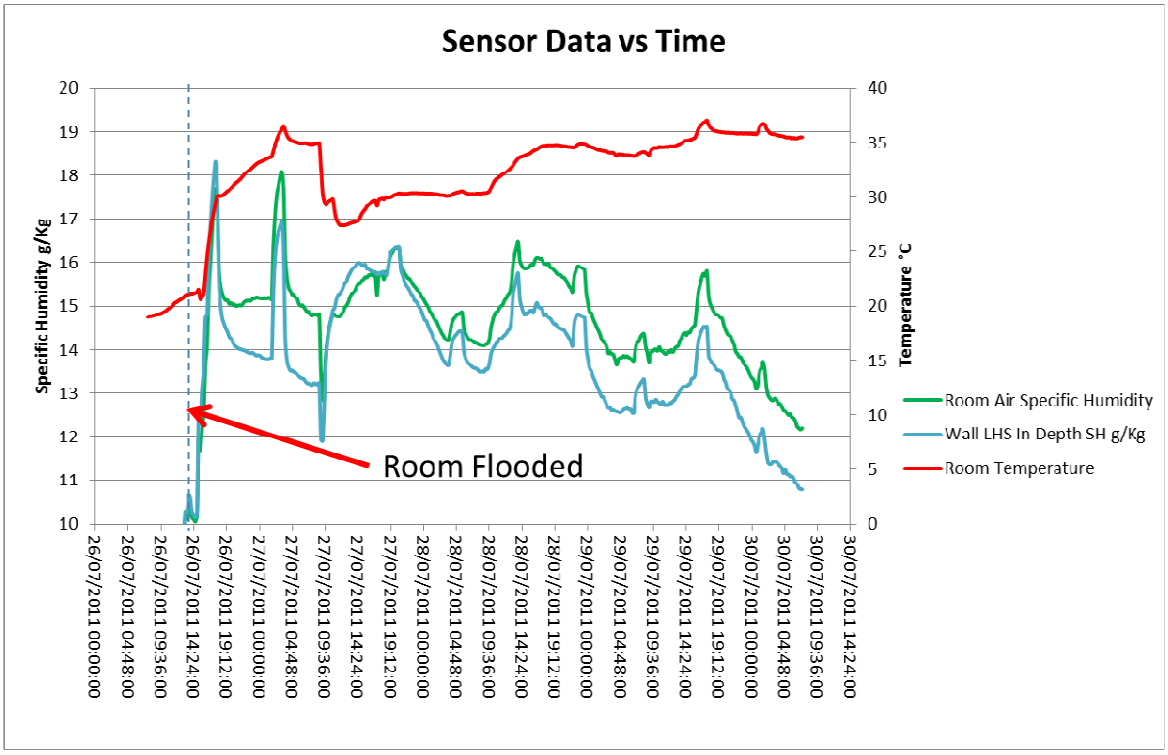
The actual industry standards are often much less than optimum for a number of reasons.

1. Victims of flood damage often turn off machines because of noise and fear of high electrical running costs. (Drymatic sends a text to the technician if this happens)
2. Technicians are tasked with many flood sites at the same time, which means long hours and journeys to site to monitor conditions and adjust drying systems to achieve fast drying times, if fast drying times is the objective.
3. Where price constraints from the service providers are to set prices as part of a contract then incentives to perform quickly are over ridden by the prices achieved.
4. Lack of resources during claim surge times often means reduced numbers of drying kit as fixed price contracts rely on "drying" not "speed"
5. Where victims are moved out to alternative accommodation then time becomes less of an issue due to building work taking a greater time to complete than drying, by its very essence building is more destructive and many wet materials are torn out and therefore do not require drying, indeed re-plastering stripped walls requires water to be re-introduced, this is a whole other subject and is not covered here in a technical paper but is available from NFS technical resources. Additionally, alternative accommodation is usually for a set period of 6 months and speed drying is not required.

Results and Observations

During use of the system it was observed that it operates at a substantially reduced noise level compared to standard drying equipment. This can be a significant benefit when occupancy is maintained during drying.

In the graph below for clarity we present the data from the room sensor in the base station and one of the wall sensors. The independent hygrometers confirmed that the room had been returned to an acceptable level of dryness at the end of this test.



Why is the Drymatic especially needed at all?

The NFS observations are that as economic conditions impact claims then labour is the element most costly to effective drying. Restorative drying is a major cost saving for insurance claims and is less destructive as many materials are saved in the process, thereby reducing overall costs by avoiding alternative accommodation, and costly building work.

The noise level and containment of heat stress to a single room lends itself to a more stress-free drying for the claimant. The in-built kilowatt hour meter tells a very true picture of actual electrical costs. Where there is no pressure on the drying contractor to perform fast results inevitably the electrical costs go up, as the site is un-monitored and is left drying for longer periods than necessary. The Drymatic, because of its gentle heat and internal controls switching from re-circulation, exhaust and drawing air from the driest source, automatically archives outstanding results in a quiet and remotely controlled and monitored process, which on the day of complete drying can be switched off and finally inspected.

Cons two man handling required if installed up stairs.

In conclusion:-

The Drymatic is a portable device which can be installed internally or externally to a flooded area. A machine of the future, as it has low maintenance, few moving parts, no harmful CFCs and its green credentials will be acceptable in a world very conscious of energy costs. The use of heat is now

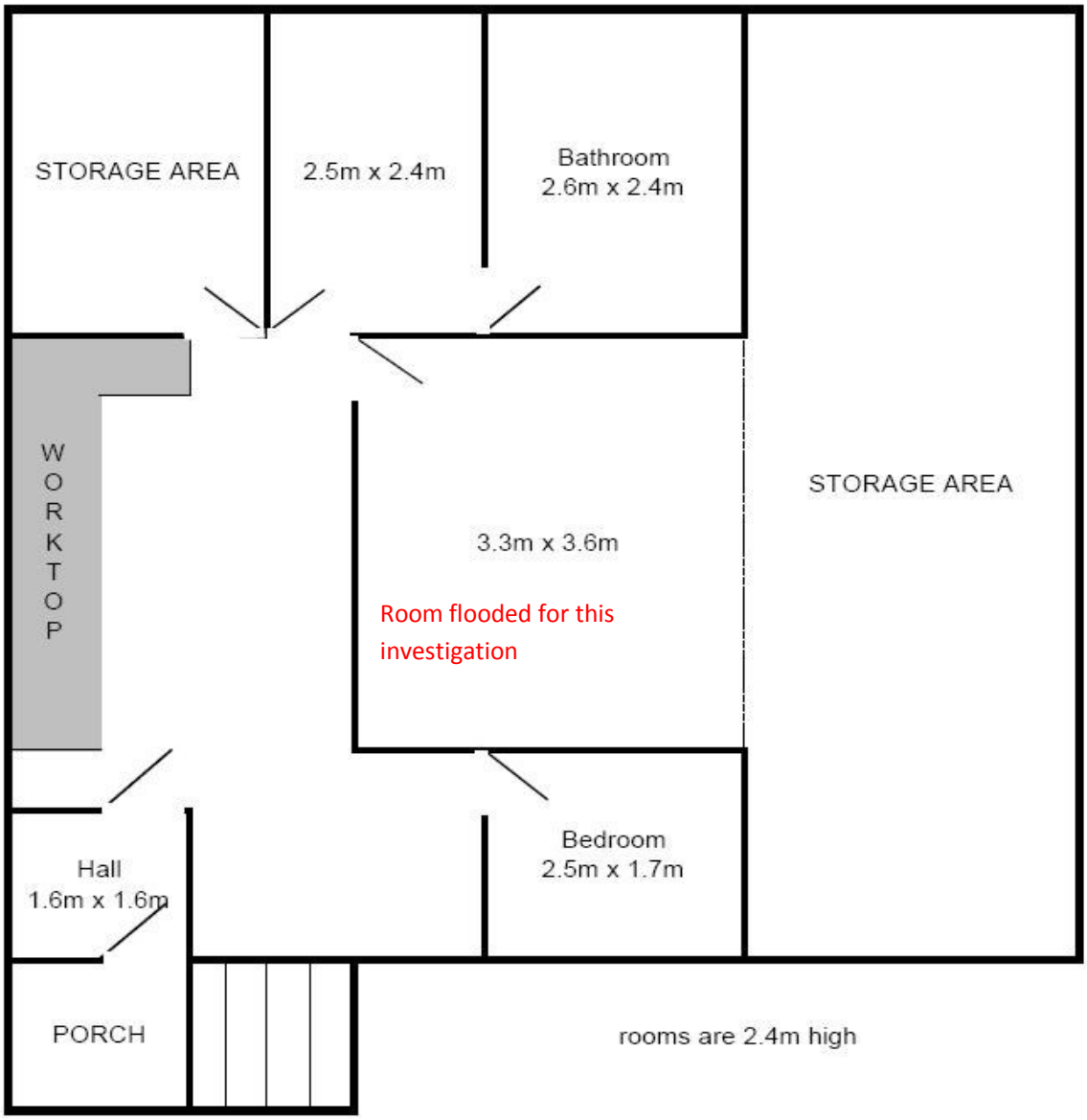
accepted by the industry and is only common sense in terms of drying. The use of heat has long been used by dehumidification as a second phase of drying when using refrigerant drying. It does not have any limitations as in the case of refrigerants which cease to work in higher temperatures. With the internal controls which even desiccants do not have, the RH sensor, Temperature sensor, Specific Humidity recorder plus the SIM card technology make this machine fill a place in drying that previously was not available.

Additional Manufacturer Profile

In addition to the Drymatic System, DBK have also launched the Drymatic Boost and the Drymatic Wall and Floor System (Not tested by NFS in this investigation). The Drymatic Boost is an auxiliary heat source that was primarily designed to help increase the ambient temperature of air within the room being dried – especially in countries were the winters are particularly cold i.e. Nordic countries. During the development, DBK formed a partnership with Direct Air Dryers Ltd and the Drymatic Wall and Floor Systems were launched. The Drymatic Boost now compliments this system as it can be coupled to any of the mat systems to provide heat – dramatically improving the efficiency of the drying process.

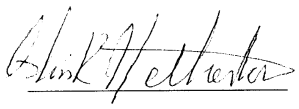
Disclaimer: - The National Flood School cannot be held responsible for the operational use of the Drymatic. The National Flood School recommends, in common with all drying equipment, on site, technical training in the use and control of the drying environment, in particular the relevant health and safety procedures as recommended by Her Majesty's Government and the British Standards Institute publically available code of practice known as PAS 64. This document was authored by The NFS with a committee of Industry experts under the direction of BSI. Nation Flood School© Copies available by payment of appropriate fee.

APPENDIX 1 – Flood House Floor Plan



www.nationalfloodschool.co.uk.

Signed on behalf of NFS



Date: 31st August 2011

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