CASE STUDY

Dry Air Protection of French Air Force Aircraft and Helicopters in Long Term Storage

BACKGROUND

There are various reasons why the French Air Force need to store aircraft. For example:

- after production, but prior to being taken into service in their regular bases
- for aircraft in reserve
- for older aircraft no longer in service or waiting to be sold

Examples of aircraft that are stored for these reasons are:

Air Force

Long term storage

Mirage F1C, F1B, 3B, 3E, 3R, 5F, 4, CM 170R Fouga Magister, Alpha Jet, Jaguar

Operational

Mirage F1CR, 3C, 2000C, 2000B, 2000N

Naval Air Force

Long term storage

Nord 262, Breguet Atlantique, Neptune

Operational

Super Etendard

In addition to this, some civilian aircraft such as Mystère 20 and Airbus are also stored, as well as military helicopters. Handling these highly technically sophisticated aircraft in storage does, of course, create a maintenance problem.

Munters

THE PROBLEM

Aircraft storage is not a simple matter and dismantling them to be put into store as individual components is not the answer. It takes several thousand man-hours to restore an aircraft to air-worthiness. The ideal solution is to store an aircraft ready for flight fueled up, with its delicate radio and electronic systems fitted. However, in ambient conditions the flexible material used in the fuel tanks of a Mirage, for example, would not withstand a prolonged period of storage. In a dehumidified environment the aircraft can be left fueled up.

However, storage or preservation of materials is most often carried out in an environment where the level of humidity is too high. This is the case for the French Air Force fighters on standby or in service. As you would expect, these modern jets represent the very frontiers of technology and their components (engine, electronics, avionics etc.) are very sensitive to air pressure humidity, which is one of the basic causes of metal corrosion and failure of electronics. In order to protect the aircraft from this it is essential to maintain the hygrometric level of ambient air at a maximum value of 35% RH. This is the condition at which electronic components are effectively protected and corrosion is prevented.

THE SOLUTION

In order to create an environment with 35% relative humidity there are two possible solutions:

Heating, lowers the relative humidity of ambient air, but does not reduce absolute humidity (i.e. actual moisture content of the air). Thus contact of the air onto a cooler surface will, at best, increase relative humidity, thereby aiding the corrosion process, and at worst, cause condensation which often has devastatingly corrosive effects on many materials. Hence, the effectiveness of heating to control relative humidity is limited. In addition the energy costs incurred in achieving 35% RH by heat are extremely high, especially in poorly insulated buildings.

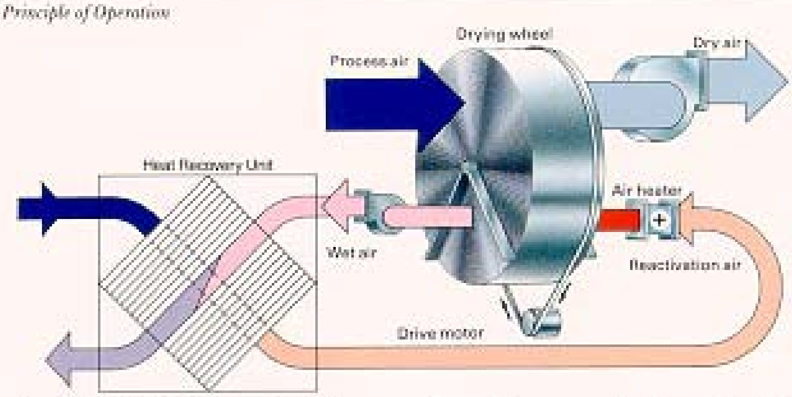
Dehumidification, acts directly against the factor to be controlled i.e. moisture, by removing water vapor from the air. As this process is not affected by temperature, relative humidity is controlled accurately, without fluctuation. In addition controlling humidity by dehumidification is an efficient method, incurring low energy consumption, and (as the building doesn't require insulation) low construction costs.

The Munters Dry Air System comprises:

- one or more dehumidifiers (see fig. 1 for operation)
- a network of blower ducts for efficient distribution of dry air
- a control system consisting of hygrostats, connected to one or more of the dehumidifiers, positioned to ensure the entire storage area is maintained at the specified relative humidity.

Through research and development the French Air Force has incorporated Munters dehumidification in its own solution to the problem of long-term aircraft storage.

Fig. 1 Principle of Operation



The MA10000 is based on Munters unique Honeycombe ® sorption* drying wheel:

- Process air passes through the drying wheel and leaves the dehumidifier as dry air.
- Heated reactivation air collects the moisture absorbed by the drying wheel and leaves the dehumidifier as wet air.

At Chateaudun the dehumidifiers installed are equipped with a heat recovery unit which preheats the incoming reactivation air by means of the warm, wet air leaving the dehumidifier.

This unit offers an energy saving of 30-40%.

* Sorption = combined absorption and adsorption.

At Chateaudun (100km South West of Paris) a number of storage hangars are equipped with the Munters Dry Air System described above, typical of the design is the one illustrated in fig. 2. Here 3 model MA10000 Munters dehumidifiers are employed to supply 28000m^3 (16,500 scfm) of dry air per hour into a 144000m^3 (5,085,000 ft^3) flexible enclosure within a concrete hangar. In this case 40% relative humidity is controlled. The installation is over 10 years old. At that time 40% RH was considered the optimum condition for the particular requirements of the French Air Force. That condition has since been revised to 35% RH for new installations.

Installation of three MA10000 Units

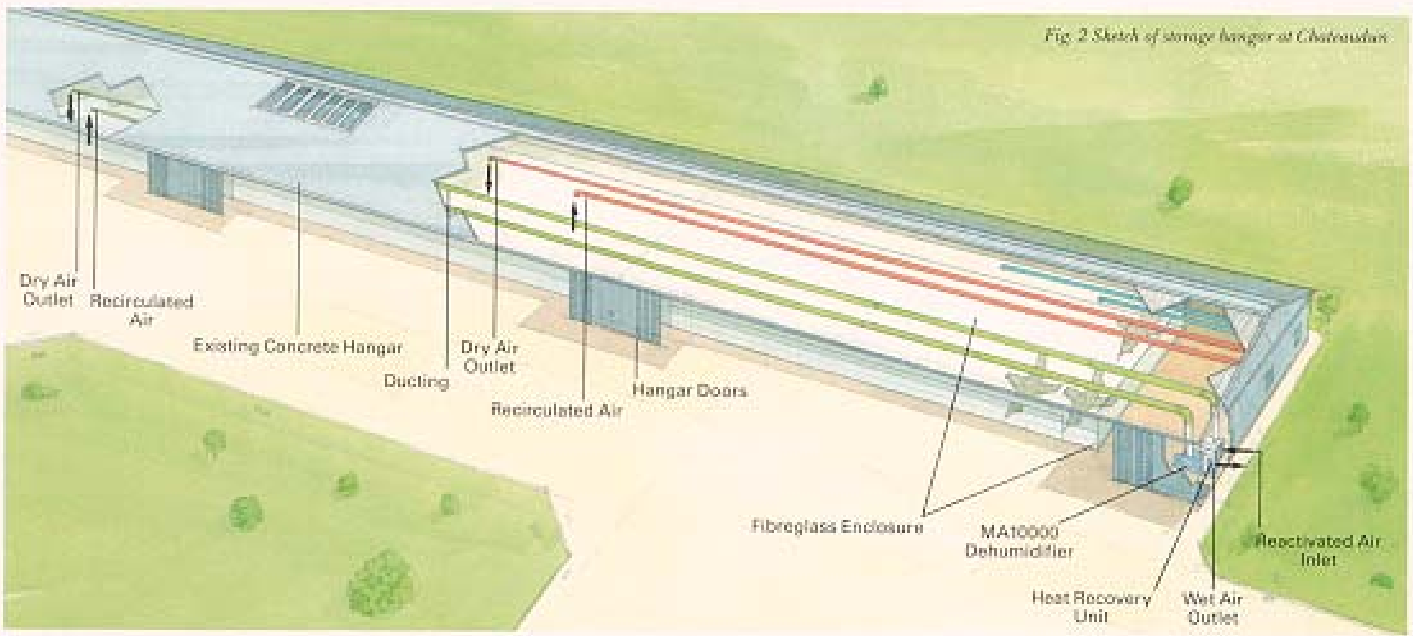


Fig. 2 Sketch of storage hangar at Chateaudun

The enclosure which is resistant to water vapor, is designed to effectively seal the hangar from moisture ingress. Thereby reducing the moisture load for the dehumidifiers, which, in turn, reduces their size, capital cost and energy consumption.

The enclosure consists of 16m × 13m (52 × 43ft) sheet of 105 g/m^2 (151 gr/ft^2) of fiber glass fabric. Both sides of which are coated with non-flammable PVC with a porosity factor of less than 12g/m^2 (17 gr/ft^2) of water vapor per 24 hours at 20°C (68°F) and 95% relative humidity. It is suspended from the roof of the hangar by metal chains and cables which are attached to the galvanized steel frame. The floor is completely leveled and coated with three coats of a two-component epoxy resin, thus avoiding any moisture ingress through the concrete. The doors are large enough to accommodate the passage of aircraft with spans of more than 40m (130ft). The Munters drying system is powerful enough to return to the 40% relative humidity condition required for the storage of aircraft, once they have been opened and closed.

Ancillary doors, providing access between chambers, are of the swing-door type fitted with rubber seals. These doors are only open for 20 seconds and the air they allow to enter the enclosure does not effect its operation.

Of course aircraft stored full of kerosene are fully equipped with safety, detection and fire-fighting devices.

BENEFITS

INCREASED AVAILABILITY AND LONGER OPERATIONAL LIFE

- Aircraft stored in an area with controlled humidity for up to four years, have been shown to have suffered no effect on their operational life, effectively increasing it, before major overhaul, from the normal nine to thirteen years.

LOW CONSTRUCTION COST

- A hangar of similar construction (for which figures are available) illustrates how cost effective a controlled humidity enclosure is. The enclosure of 25,350m^3 (895,000ft^2) houses 25 Mirage aircraft and cost the French Air Force £300,000 ($525,000) in 1982.

LOW MAINTENANCE

- The Munters wheel is impregnated for life and protected by dust filters. Normal maintenance of these filters is all that is required.
- The mechanical section consists of two motor driven fans and a geared motor – again very simple units to maintain.

LOW OPERATING COSTS

- Operating costs for this type of enclosure are much lower than for heating.
- Power consumption for the storage of 25 Mirage fighters being only 25kWh compared to an estimated 450kWh for heating.

GREATER FLEXIBILITY BRINGS LOWER CAPITAL COSTS

- The ability to store equipment and maintain its original value and performance means smoother work and delivery schedules for equipment suppliers. This greater flexibility on the part of purchasers enables them to work with manufacturers to maximize this benefit to achieve lower capital costs.
- The benefits of increased operational life are continued in longer periods against which the capital cost of the aircraft can be depreciated.

HIGH OPERATIONAL EFFICIENCY

- All important availability of equipment at stand-by quality is achieved at the most cost efficient rate.

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