

CONTROLLED HUMIDITY STORAGE

BY

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The following article is the substance of a lecture given to officers of the Ministry of Defence (Navy) at Bath in September, 1964, by the Author, who was at that time the Commanding Officer, Marchington Military Station, Uttoxeter.

Some of the material used for this lecture will necessarily be fairly basic. It is designed to put across the idea of Controlled Humidity Storage and not intended to delve deeply into physics.

Almost all materials are subject to deterioration by natural forces unless steps are taken to counteract this. Deterioration is inherent in some materials by their very nature, as a function of age, or as a result of their association with other agents. The primary causes of deterioration include such chemical and physical agents as acids, alkalis, salts, moisture, sunlight, ozone, and heat and cold. In addition, there can be biological attack against certain materials. The various forms of attack will be discussed in detail, and it will be noticed running through this, the fact that moisture is the most damaging, since it is the one factor common to most processes of deterioration.



FIG. 5—A DRICLAD COMPLETE ENCLOSURE

filtration of moisture into storage sheds through floors, but this is not significant.

Infiltration into plastic enclosures such as those described later is calculated on the permeability of material used for the enclosure. This is surprisingly high. Figures for instance for 10 thousandths-inch polythene are 2 Grams/M²/24 hours and for 35 thousandths P.V.C. are 6 - 7 Grams/M²/24 hours.

We are using a proprietary material known as 'Driclad' made by Export Packing Services of Sittingbourne. This serves our purpose very well. The permeability of this is 8 GRM/M³/24 hours and we now use the standard term for measurement of this permeability 'Moisture Vapour Transmission Rate'. Clearly these standards of MVTR are reached through applying them to a standard condition. This is to British Standard 3177 at 90 per cent R.H. 38 degrees C.

The American Army is absolutely sold on the principle of dehumidifying, and they try to put everything possible into dehumidified storage. They do not have enough dehumidified space to put everything in, so they have drawn up a list of priorities which in fact encompasses war-like equipment and textiles, tentage, etc. For instance, bread and butter vehicles are placed into dehumidified storage when we believe that an Exercise System of Vehicle Storage is less costly and less wasteful of dehumidified space. The Americans found that during the Cuba Crisis, dehumidifying really paid off in that they were able to issue, really quickly, war-like stores out of storage depots in first-class fighting condition, which required very little work indeed, if any, to be done to make the equipment fit for issue. This, they believe, is one of the main benefits of dehumidified storage, that is, the ability to issue equipment fit to fight immediately.

The British Army have been involved in dehumidifying for a considerable time, if we regard chemical methods such as Method 2 Packs as coming under this heading. It is only recently that we have turned our attention to dehumidifying in, what the Americans call, the dynamic sense. A stores shed at Cod Donnington is now being prepared for dehumidified storage by a large absorption machine. This project is under the control of the Ministry of Public Building and Works, but it is guided by a Steering Committee on dehumidifying under the chairmanship of the Commander, Stores Organization. The Commander, Vehicle Organization, has been engaged in dehumidifying work for the last two years, i.e. dehumidifying individual fighting vehicles. This is storage by wrapping of individual tanks in 'Driclad' covers, and placing inside the enclosures large quantities of silica gel. This has proved most successful, and a tank has recently been inspected (it was a Centurion Mark VII) after 20 months of storage in this manner, and it emerged in perfect condition after this period. The vehicle was subjected to a critical IFVME examination of all facilities including the gun and wireless set, and no fault could be found whatsoever. This vehicle had no attention whatsoever in 20 months. It was fully fuelled, the only item removed before being placed in the enclosure was the battery. When a battery was fitted, after the shelter had been opened, two pumps on the KI-GAS, it started on the first touch of the button. The

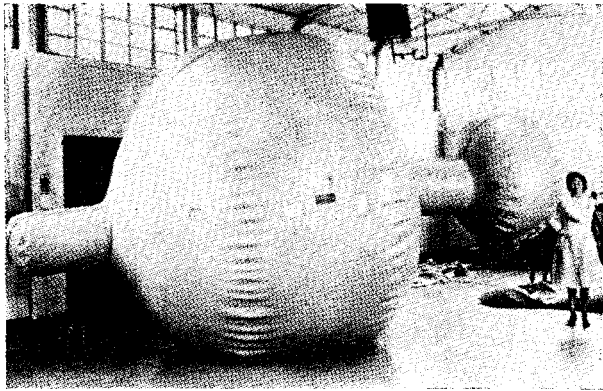


FIG. 6—A DRICLAD COVER FOR A LARGE ARMATURE AND EXCITER BEING PRESSURE-TESTED FOR LEAKS

in these enclosures rises to a high level. In the last year a laboratory has been started at Marchington for further investigations into the use of small dehumidifying machines, and the effects of humidity on various materials. The chart shown earlier was taken from the Marchington Laboratory which has been extremely useful in determining the performance of various machines under various conditions of humidity and temperature. It has been possible, in this small Laboratory, to simulate Singapore conditions of high humidity and fluctuating temperature. The machines have been tried out and their efficacy in neutralizing the Singapore climate determined. I believe that we are ahead of the Americans in this application of dehumidifying i.e. the protection of individual vehicles. The advantages of such a system are obvious; it means that a squadron or even a Regiment of tanks can be put in stock pile almost anywhere in the world, whatever the climate, and be instantly ready for combat without any maintenance or preparation being necessary. Furthermore the cost of protecting an armoured vehicle worth, say, £80,000, is only in the neighbourhood of £400 for the enclosure and the machine. Remember too, that the wages of one labourer for one year are considerably in excess of the cost of this equipment. Clearly, the saving in labour charges on maintenance alone is significant. Since the subject of costs has been introduced here, it is perhaps the place to point out that the initial cost for dehumidifying storage sheds, assuming that they have not been custom built, is as follows:—The American figures for initial cost, including building conversion and installation of machines is 3s. 6d. per sq ft. Operating costs, i.e. power, etc., are on average 6d. per sq ft. per annum. Ministry of Public Building and Works figures in this country, and which have been applied to Donnington are:—2s. 8d. per sq ft. for capital costs, conversion and machines; running costs, less maintenance, 3½d. per annum per sq ft. using steam heat regeneration (11½d. using electricity for regeneration).

Let us summarize the main advantages of dehumidified storage. Clearly, the advantages in the context of preserving equipment have come out so far. In fact, in many cases obsolescence would come before scrapping due to corrosion or other forms of attack. There is a great saving in costs. Maintenance of items held in dehumidified store is kept to an absolute minimum since there is no deterioration. Inspection too, would show a tremendous saving since the items which have to go through a periodic inspection cycle would not have to be de-preserved for inspection and functional test and then re-preserved before being placed back into store. Another great advantage is in the realm of the storage of Method 2 Packs. Method 2 Packs placed in dehumidified storage will of course not have any of their 'life' expired. This means that they could be kept indefinitely in dehumidified storage and their life will only begin to run out once they leave it.

type of cover used is shown in FIG. 5.

An order has now been placed for enclosures of 'Driklad' supported by framing. In the very near future, some of these shelters will be distributed throughout the world for trials, and they will be dehumidified by a small refrigeration type machine, which has been flame-proofed to Buxton Certificate Standards. This is necessary as a petrol vapour concentration

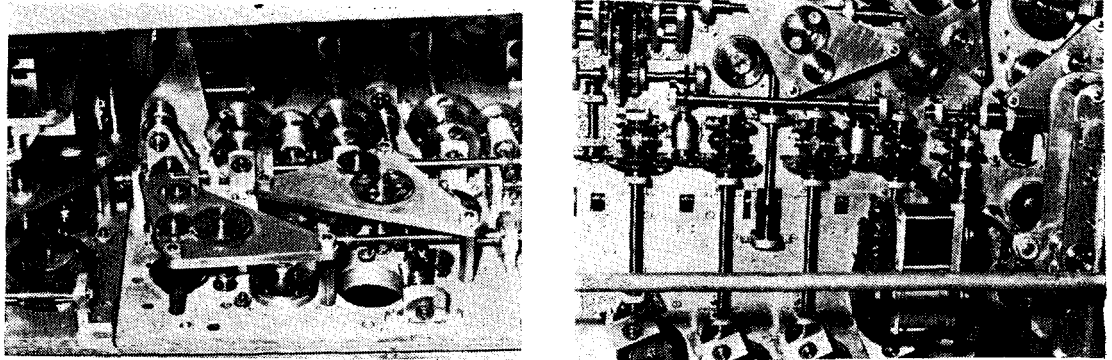


FIG 7—TWO VIEWS OF THE GUN DATA UNIT, MK. 1, MOD. 1, TAKEN IN Q2 T.S. IN H.M.S. *Blake* IN NOVEMBER, 1964. THE COMPARTMENT HAD BEEN DEHUMIDIFIED SINCE OCTOBER, 1963

Method 2 Packs kept in extended storage in a main base would not have to be opened and re-packed with desiccant at regular intervals as happens now. A full costing of the savings due to dehumidified storage from the point of view of maintenance, inspection, repair and packaging, to my knowledge has never been done. It is my view that the main saving, which can never be costed, which would come from the adoption of dehumidified storage, is the combat fitness of equipment so stored. This, of course, is a very important factor indeed, and American experience has proved this to be true.

This really is a big subject. One could talk at considerable length of American experience, of our own work, conclusions we have drawn from this, but clearly time is limited. It is hoped that this lecture has shown that we, in R.A.O.C., have appreciated the tremendous benefits to be obtained from dehumidified storage, and how we are using this principle to increase the efficiency of our function.

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D.F.M.'s NOTES ON NAVAL APPLICATIONS

(1) H.M.S. 'Blake'—M.R.S.3 Systems and Gun Turrets

Preservation by dehumidification was completed in October, 1963. An inspection of the systems was carried out in July, 1964, with the following results:-

- (a) 'Y' turret gearboxes were opened and stripped and all associated shafts, gears, bearings and internal surfaces were inspected. No evidence of corrosion was found.
- (b) Electronic equipment. Insulation readings were over 50 megohms as compared with the operational reading of 20 megohms. Except for valve failures all units inspected came up to specification. The system ran up and came to the ready without any failure at all. After five hours 'A' system had 12 minor faults which were easily cured, some of which may have been present before preservation.

During this nine-month period no maintenance had been carried out. Total cost of preservation of all gunnery systems and turrets, not including directors, was £2,000. This sum is not lost because the preservation equipment is still available for use elsewhere.

(2) Gearbox in H.M.S. 'Dreadnought'

Air in the gearbox casing has been dehumidified with the result that the gear surfaces above the oil level have not become corroded. This application is being extended to frigate main drive gearboxes.

(3) C.M.S. in Reserve in Singapore

Trial is under way to preserve a whole ship using the dehumidifiers described in the above article.

(4) Selected Weapon Compartments in Ships of the Active Fleet

Dehumidifiers are to be used to improve the environmental conditions in which some equipments operate with a view to reducing maintenance.

(5) Ships in Refit

A start is being made to preserve equipment in compartments which are left unattended during refits. A study is in hand to consider the use of covers containing dehumidifiers to protect upper deck equipment in a similar manner as proved by the Army's tank trials.

(6) All equipment is being supplied as patternized Naval Stores except for the rotary bed machines.
