# DEHUMIDIFICATION OF SHIPS

by

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The chief cause of deterioration in ships in reserve is moisture, and the best means of preserving the interior of a ship as a whole while laid-up is to reduce the humidity within the ship to a point at which corrosion, rot, and mould do not occur. This process, which replaces the laborious chipping, painting, and greasing routine, is termed dehumidification ; thus another word of many syllables becomes part of our technical vocabulary.

If a relative humidity of 25–30% is maintained within a ship, deterioration due to moisture ceases. Engineers have employed the principle for many years in placing boilers in the " Empty closed and limed " condition.

Furthermore, low humidity conditions are ideal for the storage of the many items of equipment and materials required when the ship is brought forward for service.

There is a complete absence of insects and vermin in a dehumidified ship since these troublesome creatures cannot exist where there is no moisture for their subsistence.

## Solid Adsorbents

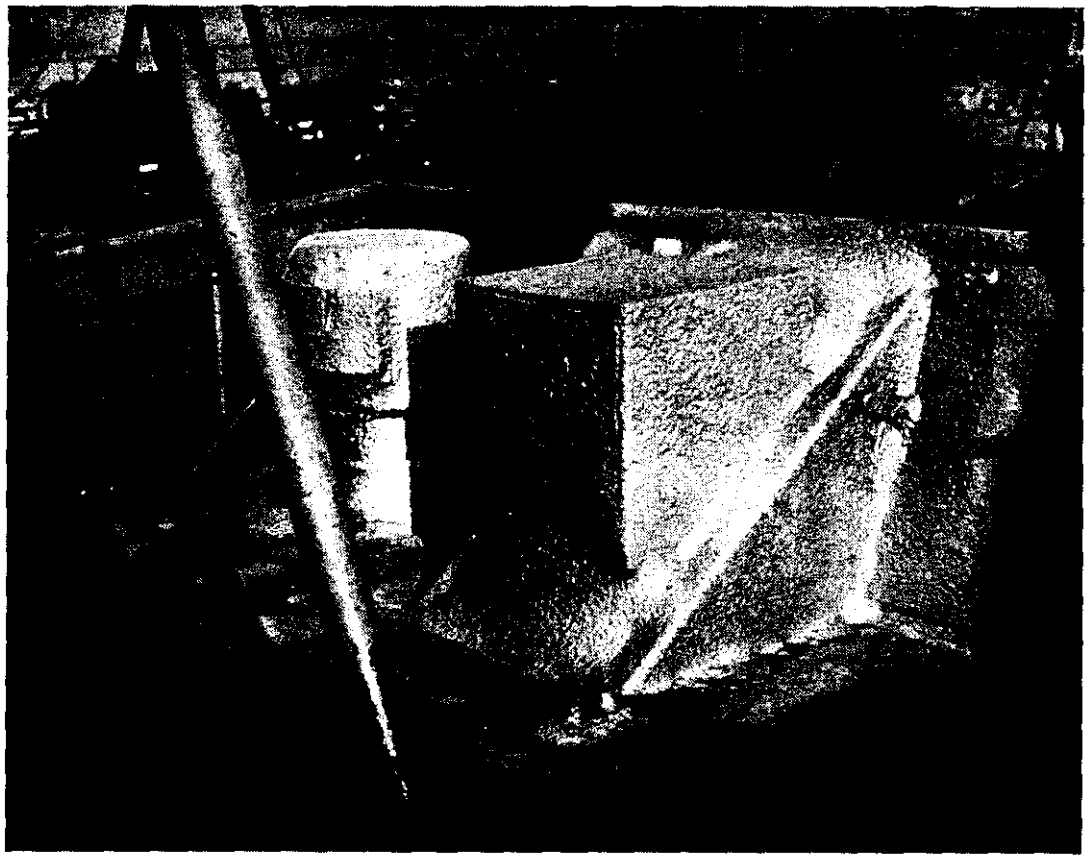
Ship dehumidification has been made possible by the production of solid adsorbents. These materials, such as silica gel and activated alumina, are porous and have the property of taking up water vapour by virtue of their cellular structures which present large interior surfaces for contact with the air to be dried. Adsorption is essentially a surface effect and a material which has adsorptive properties can be reactivated by the application of heat which drives off the adsorbed substance ; it can pass through an indefinite number of adsorption and reactivation cycles since no chemical change takes place within the desiccant. Adsorbents must not be confused with absorbents which undergo a physical or chemical change when taking up moisture.

## Dehumidification

Moisture from within a ship can be removed by placing containers of adsorbent material in each compartment, that is, by static dehumidification. This process, however, involves the use of a very large quantity of desiccant which must be frequently replaced, and there is an ingress of atmospheric moisture into the ship during the operation of renewing the desiccant. Equipment is necessary for the reactivation of the saturated adsorbent. Static dehumidification is therefore uneconomical in material and man-power.

Alternatively, the humid air can be pumped from the ship, passed through a bed of adsorbent material, and returned to the ship as dry air. This is dynamic dehumidification, and it is with this we are chiefly concerned.

A dehumidification machine consists of two fans, two desiccant beds and a reactivation heater. One fan draws air from the ship, passes it through the



H.M.S. " URCHIN."—VENT TOPS AT BREAKWATER. TYPICAL EXAMPLE OF USE OF PLASTIC FOR SEALING OPENINGS

desiccant bed in current use, and discharges it back into the ship. The second fan passes heated atmospheric air through the desiccant bed being reactivated, the moisture from the latter being discharged to atmosphere. The beds are changed over by thermostatic control each time the reactivation cycle is completed, so that each bed in turn is used for drying.

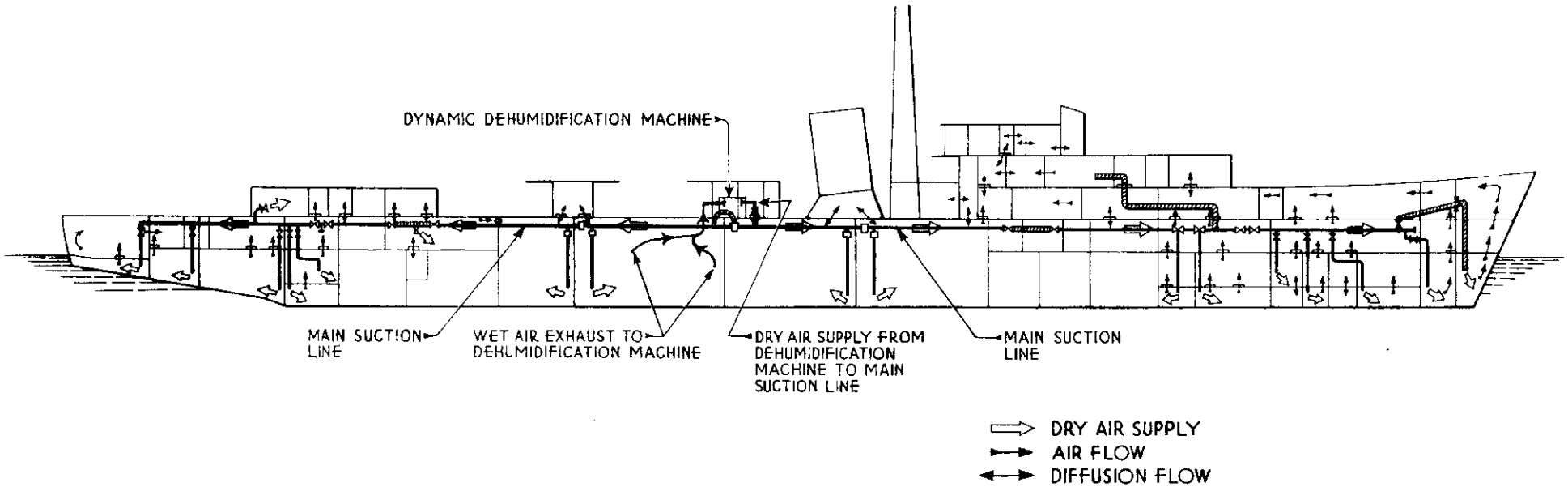
**Measurement of Humidity**

Distant reading hygrometers of the electric resistance type are used for the measurement of relative humidity in the ship. Sensing elements are placed in selected compartments, and wired to an indicating instrument through selector switches.

**Air and Watertightness**

As may be inferred, the ship must be made completely watertight below the water line and sealed against the atmosphere. With the rise and fall of atmospheric temperatures and barometric pressure, a ship " breathes " through the openings which normally exist even though all hatches, doors and covers are closed down. The funnel is notable in this connection, and leakages inevitably exist through some doors and covers.

The required standard of air and watertightness must be achieved without undue prejudice to the notice of the ship for service, and without affixing seals or blanks under water which necessitate a docking for their removal when the ship is brought forward.

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Openings above and below the water-line are covered with a non-porous plastic. A film-forming resin is largely used—in a volatile solvent this material can be sprayed, and it can be stripped off easily when no longer required. The plastic cover is given a protective coat of bitumen, and for above-water work a final flash of aluminium paint is applied in addition. A fine meshed textile netting is stretched across large top-sides gaps and openings to provide a base on which the plastic is sprayed. The funnel, exhaust pipes, ventilation openings, voice pipes, etc., are closed by this method.

The continued tightness of the joints of weather deck doors, hatches, and side scuttles, can be ensured in most cases by re-rubbering and applying strippable lacquer to the rubber before final closing. It is necessary, however, to seal the clips of doors and hatches with the plastic coating.

On completion of sealing against the atmosphere, a low pressure air test is applied to the envelope of the zone. It is convenient to use smoke for tracing leaks.

All underwater valves and fittings are carefully refitted when preparing for dehumidification. Stern glands, the rudder gland, and sea valve spindles are repacked and the glands are hardened down.

Because of the difficulty in making large sluice valves absolutely watertight in every case, a plastic cover on a plyboard backing is applied over main circulating inlet and discharge orifices. The annuli around Asdic domes and rudder stocks are similarly treated, using rope in these cases as a support for the plastic seal. To facilitate the removal of these underwater plastic covers by diver, piano wire with toggled ends is embedded around the edges under the plastic.

**Installation of Dehumidification**

The dehumidification machine is installed outside the zone it serves.

Dry air is delivered by the machine through temporary piping and hoses into a ship's piping system. The main suction system or the firemain are convenient for this purpose, as these systems are connected to nearly every compartment in the main hull. The main suction system is particularly suitable as the branches from this pipe line extend to the bottom of the compartments, thereby giving the dry air a long return path. The return path back to the suction of the machine is arranged through existing openings in decks and bulkheads, but it may be necessary to make some temporary openings in addition to facilitate air movement. A typical arrangement is shown in the folding plate

The distribution of dry air to the various compartments is controlled by the adjustment of the branch valves of the system used for supply. An air flow meter is used when making initial settings, and subsequent adjustments are made to suit the humidity recorded in each subdivision.

In destroyers and smaller ships, the dehumidification of the whole of the interior is within the capacity of one machine. In larger ships there will be two or more zones each in connection with a separate machine. The few compartments which are not conveniently situated to suit the path of dry air are excluded from the main zone or zones and are statically dehumidified.

**Treatment of Propeller Shaft Bearings**

Because it is impracticable to turn propeller shafting at routine intervals in dehumidified ships, stern tube and " A " bracket bearings must be sealed against the ingress of sea water to prevent the formation of marine growths and/or corrosion products in these bearings.

The sealing of whitemetal-lined propeller shaft bearings is a simple matter, the bearings being packed with the normal lubricant, grease, or oil as the case may be, and the outboard ends closed with waterproof seals which will break at the first movement of the propeller shafts when the ship is brought forward.

The sealing of rubber-lined bearings is a more difficult problem, however. Furthermore, this type of bearing is particularly vulnerable to damage when the ship is brought forward for service if marine growths become attached to the shafts between longitudinal bearing strips during the laid-up period.

Great care is necessary in selecting the substance to be used for packing the voids between rubber bearing strips. Rubber is susceptible to deterioriation if in contact for a long period with a remarkably wide variety of gels and soaps. A further determining factor is that the substance chosen must readily disperse when the propeller shafts begin to revolve on bringing the ship into service, so that a free flow of water through the bearings is not impeded ; it must act as a temporary lubricant during dispersal. The consequences of a spate of " A " bracket bearing failures following the bringing forward of laid-up ships in an emergency, when both ships and dry docks would be at a premium, can be imagined. From experience to date however, there is every reason for confidence that a gel in water of either corn starch or agar-agar will meet the exacting requirements mentioned above. Neither of these substances has any ill effect on rubber ; both are thixotropic, so that dispersal is assured. To prevent mould growth in the gel, an addition of 0.1% of sodium-ortho-phenyl-phenate is made. It is surprising how many algicides and fungicides have an adverse effect on a rubber-gunmetal combination, and here again careful discrimination is necessary.

Up to the present, rubber-lined " A " bracket bearings in several laid-up destroyers have been filled with starch gel. In the very near future, a basin trial will be carried out in a destroyer in which one " A " bracket bearing has been fitted with starch gel and the other with agar gel, and the ship docked after the trial to ascertain beyond all doubt whether these materials disperse satisfactorily.

After filling both rubber and whitemetal-lined propeller shaft bearings, a waterproof stopping of castor oil and beeswax is applied at each end. This stopping is moulded into a generous fillet and a plastic cover is formed by spraying to keep it in position.

**Preservation of Machinery**

The working surfaces of main and auxiliary machinery which will be in undisturbed contact with each other for a long period must be specially preserved.

First, it must be determined whether unacceptable quantities of chlorides are present in the lubricating oil contained in the various systems. If so, sodium nitrite and dewatering treatments are carried out. A special preservative compound containing lanoline and corrosion inhibitors is circulated around the lubricating oil systems and the machinery turned so as to cover working surfaces with a protective film. All surplus compound is afterwards drained off and the drain tanks filled with a charge of the normal lubricant, ready for the time when the machinery is again required for use. The protective film of preservative compound which remains over working surfaces will disperse harmlessly into the lubricating oil when the machinery is brought into service again.

Apart from the special measures described above, main and auxiliary

machinery is preserved in accordance with normal practice in the Reserve Fleet. In some cases it is possible to take advantage of the low humidity within the ship ; for example, the access doors of main turbines are left off and the openings covered with fine mesh wire screens.

**Conclusion**

It is evident from the foregoing that the preparation of ships for dehumidification is a heavy commitment and the work involved can be done only at the expense of other things. It must be borne in mind, however, that a ship which has been placed in the dehumidified state requires very little further attention and the maintenance crew formerly required is released. As the programme progresses, crews will be released in increasing numbers to assist in the preparation of the dwindling number of ships awaiting dehumidification, and the snowball effect should produce a progressive improvement in the state of the Reserve Fleet.