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Notes on the Storage Capabilities of Impregnated Clothing

The logistic aspects of chemical warfare permeable protective clothing have recently been highlighted by the issuance of U. S. Army Regulation 700-62 entitled "Logistics (General) Chemical Protective Clothing Policy and Utilization of Certain Chemical Corps Units and Equipment in Combat Areas". The purpose of this regulation is to provide a policy for a field commander in planning for the maximum utilization of protective equipment, and chemical protective clothing in particular.

To implement this regulation requires that consideration be given to the packaging of impregnated clothing in order to avoid potential deterioration and maintain its protective qualities. Such dangers in permeable protective clothing have long been recognized and were the subject of considerable study during World War II. At the initiation of that conflict a solvent solution of CC_2 with chlorinated paraffin was applied to clothing. However, its useful life was rather short, for the CC_2 was rapidly decomposed in a reaction involving the production of hydrochloric acid which hydrolyzed the cotton clothing fabric.

The research program undertaken during World War II led to the process presently known as $XXCC_3$. This treatment is applied in the form of a water emulsion rather than solvent and includes as an acid accepting agent, or stabilizer, zinc oxide. With such a treatment, loss of chlorine from the chloramide (CC_2) may still be expected. However, this loss is not reflected in fabric destruction but in chemical agent protectivity.

Studies of the $XXCC_3$ process on cotton fabrics showed that the chloramide was still subject to attack through hydrolysis. Further studies were made of the various fabric prepares as they related to loss of chlorine from CC_2 on storage under accelerated conditions. It was found that, in most instances, thoroughly processed fabrics retained chlorine somewhat better than the lightly processed fabrics when stabilized with zinc oxide. This effect often has been attributed to trace impurities remaining in the fabric. Other studies have shown that the moisture content of the fabric prior to packaging or that which results from conditions of storage influence chlorine retention, and thus chemical protective capabilities. Thus, though perfect stability may never be achieved in this system, packaging in a dry inert atmosphere may aid considerably in achieving chemical stability under storage conditions.

In addition to these studies regarding the interaction between fabric and protective finish ($XXCC_3$), limited studies have been made regarding the influence of various types of packaging materials and packaging methods. However, these studies have not been carried out in sufficient quantity to enable any real findings as to their potential benefit for $XXCC_3$ treated clothing. Rather, they have served mainly to demonstrate a specific packaging concept. However, from the limited tests made it is apparent that control of the moisture content within a package by a desiccant such as silica gel might be beneficial. In addition, a packaging material resistant to the

decomposition products from $XXCC_3$ as well as the ingress of moisture would contribute to longer storage stability.

These findings with respect to the packaging of $XXCC_3$ treated clothing have a parallel in what might be considered on first inspection as an unrelated field, the packaging of germicides. In this case the QMC has developed laminated films for halogen containing germicides that are not degraded by chlorine and prevent the passage of chlorine and moisture vapor. There has also been developed a "contour" packaging system that provides a film packaged, compressed, and vacuumized item for long term storage. It is proposed under a program to be initiated in the near future that impregnated clothing be contour packaged using such chlorine and moisture resistant films and the combination studied as to its ability to effect long term storage stability of impregnated items.

In conducting these studies, major reliance will be placed upon storage in chambers which provide daily cyclic changes in temperature and moisture representative of those found in storage facilities of hot-dry and hot-wet areas. Accelerated testing using elevated temperatures within ovens or water baths will not be a major test criteria, for experience with respect to these test methods and actual shelf life of $XXCC_3$ treated items is insufficient to establish good correlation.

Until data are available from the above studies, it will be necessary to continue to extrapolate from the experiences of World War II with unstabilized CC_2. This means that bale packaging would be continued, and estimates as to storage stability would be dependent primarily upon laboratory test conditions and the actual storage capabilities of a chemically unrelated material. However, experiences from packaging other products give promise that much can be done to implement AR 700-62 as it relates to the storage capabilities of impregnated clothing and thus provide the field soldier with improved protective capabilities in time of need.