

**PRESERVATION PROCEDURES FOR  
FRESH FRUITS AND VEGETABLES AT SEA;  
WASP CLASS LHD'S**

From: AgraCo Technologies International, LLC

To: U.S. Navy Food Service Personnel; WASP Class Ships

Subj.: PROCEDURES FOR PRESERVATION OF FRESH  
FRUITS AND VEGETABLES ABOARD WASP CLASS  
SHIPS

**BACKGROUND**

NAVSUP P-486 Chap 5, ¶5701, in describing best practices for the management of air circulation in the storage environment of fresh fruits and vegetables (FFV), states that "The use of Ethylene Absorber Blankets and/or Ethylene filters are strongly encouraged to also reduce ethylene gas levels and prolong the storage life of perishable foods."

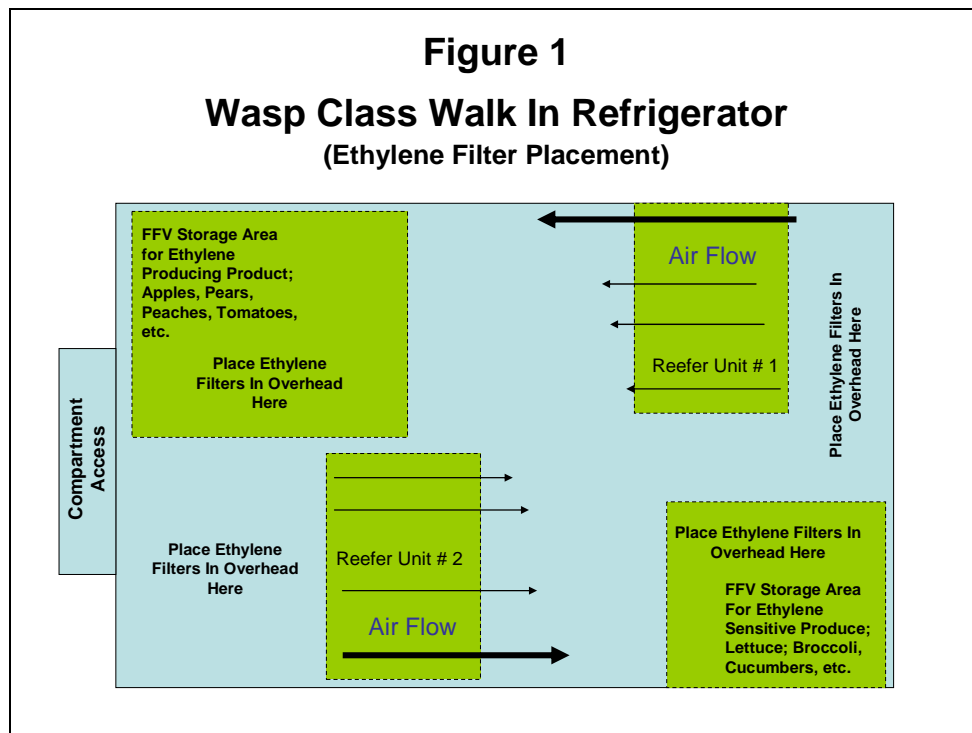
Surprisingly, no additional guidance appears to be available to assist Navy Supply personnel in responding to this recommendation. Navy Supply Corps School curriculum does not currently address the issue of FFV spoilage caused by high concentrations of ethylene gas in reefers and dry storage spaces, nor do Navy "A" and "C" school materials address this subject in any significant way. Consequently, year after year, the Navy as a whole records substantial losses of FFV through spoilage, principally caused by high concentrations of ethylene gas.

**WASP CLASS LHD SHIPBOARD STUDY**

Recently, at the request of Navy personnel, AgraCo Technologies International representatives conducted a study of food storage spaces aboard Wasp Class ships, to determine optimum configurations for FFV storage, and methods for implementation of ethylene removal filters to aid in the preservation of FFV. Actions included measurements of typical FFV storage spaces, as well as discussions regarding standard operating procedures, daily routines, and challenges facing CS personnel in the ship's operating environment. The recommendations contained in this document are a direct result of the findings and conclusions drawn from this study.

## FINDINGS AND CONCLUSIONS

1. Ethylene absorbers should be optimally placed adjacent to the intake sides of the two refrigerator units located in the walk-in refrigerators aboard Wasp Class LHD's, as well as above the storage area for fruits not requiring refrigeration, in dry storage rooms. Ethylene filter sachets should additionally be placed in fruit storage boxes in the dry storage area (See Figure 1).



2. All FFV should be separated in food storage spaces according to whether the individual fruit or vegetable is an ethylene producer, or an ethylene absorber. USDA guidelines are available to provide guidance in separating producers from absorbers. (See Figure 2.) Separating the various products will give the best chance for preventing ethylene-induced spoilage.

## FIGURE 2

USDA Tropical Products Transport Handbook  
Agriculture Handbook No. 668

### ETHYLENE SENSITIVITY

Never transport or store fruits and vegetables that produce a lot of ethylene with products that are sensitive to it. Ethylene can cause premature ripening of some products and will ruin others, such as plants and cut flowers. Cucumbers and celery turn yellow in the presence of ethylene, while lettuce will turn brown. Potassium permanganate pads can be used to absorb ethylene during transit and storage.

Table 8:  
Products that are ethylene producers or ethylene sensitive

#### Ethylene producers:

Apples, apricots, avocados,  
bananas ripening, cantaloupes,  
cherimoya, figs, guavas, honeydew,  
kiwifruit ripe, melons, mamey,  
mangoes, mangosteen, nectarines,  
papayas, passion fruit, peaches,  
pears, persimmons, plantains,  
plums, prunes, quinces, rambutan,  
tomatoes.

#### Ethylene sensitive:

bananas unripe, Belgian endive,  
broccoli, brussels sprouts, cabbage,  
carrots, cauliflower, chard,  
cucumbers, cut flowers, eggplant,  
florist greens, green beans, kiwifruit  
unripe, leafy greens, lettuce, okra,  
parsley, peas, peppers, potted  
plants, spinach, squash, sweet  
potatoes, watercress, watermelon,  
yams.

3. Ethylene filters should be replaced, on average, every thirty (30) days, in order to assure peak efficiency of the filter mechanisms, and a regular schedule of replacement, according to established practices similar to the Navy's 3M system. Eventually, ethylene filters should be included in the ship's routine maintenance procedures in some manner, in order to support ongoing attention to FFV conservation efforts.
4. Naval Center for Service Support curriculum needs to be modified to include instruction on basic FFV preservation issues related to ethylene gas and methods of reduction of ethylene gas in Navy ships' food storage spaces. Drafts of suggested curriculum will be submitted to NAVSUP for review and submission to Commander, Naval Education and Training Command (CNETC).

## **RECOMMENDATIONS**

1. Distribute above findings to all Wasp Class ships.
2. Continue to provide FFV preservation consultation and assistance to Fleet food service personnel.
3. Gather feedback from Fleet units regarding implementation of improvement measures.