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**TECHNICAL REPORT
NATICK/TR-95/028**

AD _____

NAVY PICTOGRAM FOR MARINE DEGRADABLE ITEMS

By

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PREFACE

This final technical report details the U.S. Army Soldier Systems Command (SSCOM), Natick, Research, Development and Engineering Center's (NRDEC) involvement in the development of a U.S. Navy pictogram for marine degradable items from its inception through testing, evaluation, and subsequent approval by the U.S. Naval Supply Systems Command (NAVSUP). Included is a summary report on the Behavioral Science Division's (NRDEC) assessment of sailors' reactions to the pictogram. Recommendations regarding adoption of the pictogram, methods to educate sailors about its meaning and proper usage, and application to items are also discussed.

NRDEC efforts on this project were funded by NAVSUP and conducted during the period July through December 1994.

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ACKNOWLEDGEMENTS

Numerous personnel from NRDEC deserve recognition for the successful development and approval of the pictogram. The authors would like to acknowledge fellow team members Robert Trottier, Jeanne Lucciarini and Diane Wood from the Sustainability Directorate for their packaging expertise and cooperative developmental efforts, and Michael Willhoite from the Information Management Directorate for his superior graphic art work. Thanks also goes to Science and Technology Directorate personnel including Ms. Kathy Rock for assistance on questionnaire design and formatting, Mr. Bob Stark and Ms. Jane Johnson for data collection, Ms. Shivaun Roach for data entry, and Mr. Larry Leshner (GEO-CENTERS, Inc.) for his input on data analysis.

Special recognition is given to Dr. Gerald Moy and his staff from the Food Safety Unit of the World Health Organization, Geneva, Switzerland, whose assessments of pictogram designs from an international perspective was a crucial part of the process.

Sincere appreciation is also extended to the crews of the USS Bainbridge, Mount Whitney and Barry at the Naval Station in Norfolk, VA, as well as the sailors at the Naval Station in Newport, RI who participated in the user evaluation studies. The work of Master Chief (MC) Nacua and Chief Petty Officer Cephus in Norfolk and MC Rabitor in Newport was instrumental in scheduling and conducting several tests which greatly contributed to the selection of the final pictogram design.

SYMBOLS, ABBREVIATIONS AND ACRONYMS

ANOVA	Analysis of Variance
Biopol™	Biodegradable Polymer (registered trademark)
CO	Commanding Officer
FRH	Flameless Ration Heater
IMC	Public Announcement System on board ship
MANOVA	Multivariate Analysis of Variance
MARPOL	Marine Pollution Treaty
MC	Master Chief
MRE	Meal, Ready-to-Eat
NAVSUP	U.S. Naval Supply Systems Command
NRDEC	Natick Research, Development and Engineering Center
ODCSLOG	Office of the Deputy Chief of Staff, Logistics
PRIME	Plastics Removal in a Marine Environment
SSCOM	U.S. Army Soldier Systems Command
SusD	Sustainability Directorate
USCG	United States Coast Guard
WHO	World Health Organization
S.D.	Standard Deviation
e.g.	for example
i.e.	that is
vs.	versus

SUMMARY

The Navy pictogram for marine degradable items was developed in response to a U.S. Naval Supply Systems Command's (NAVSUP) request for an instructional wordless symbol which could be directly applied to individual supply items that were safe for disposal in a marine environment. The immediate purpose of the pictogram was to identify marine degradable items to shipboard personnel in charge of separation and disposal of trash. The ultimate purpose of the pictogram was to ensure that U.S. Coast Guard officials, who will begin enforcing regulations prohibiting the overboard disposal of plastic waste at sea beginning in January 1999, would be able to identify non-toxic, seawater degradable items in the ocean.

The U.S. Army Soldier Systems Command, Natick Research, Development and Engineering Center (NRDEC) established a team of scientists and graphic artists from NRDEC and the World Health Organization (WHO) in Geneva, Switzerland, to develop and assess the pictogram. The team's goal was to design a pictogram that incorporated the criteria for use and universal understandability set forth by NAVSUP and WHO, that could be applied to a wide range of marine degradable items, and that sailors perceive as acceptable and clearly communicating marine degradability.

Several prototype pictograms were designed by the team and assessed by NAVSUP, WHO and Navy users. Focus groups were conducted to gather sailors' responses to three pictogram prototypes which differed in design and symbols used to convey degradability. Results of these assessments were used to modify and finalize the pictogram design.

The final pictogram was applied to marine degradable beverage cups and distributed to sailors at the U.S. Naval Station in Norfolk, VA, to evaluate their perception of the final pictogram in the context in which it will be used. Overall, the sailors liked the pictogram and believed that it would convey the message that an item is marine degradable.

Results of the user tests and evaluation were presented to NAVSUP, who approved the final pictogram design in December 1994. Future target items which may be identified with the pictogram include, but are not limited to, seawater degradable cups, trash bags, flatware, milk bladders and wiping towels.

NAVY PICTOGRAM FOR MARINE DEGRADABLE ITEMS

INTRODUCTION

Background of Pictograms

In 1993, it was anticipated that Meals, Ready-to-Eat (MRE) containing Flameless Ration Heaters (FRH) would be used for humanitarian assistance. The Office of the Deputy Chief of Staff for Logistics (ODCSLOG) expressed concern regarding the potential for accidental ingestion of the FRH, a water activated chemical heater, by non-English speaking humanitarian aid recipients who could potentially mistake the FRH as a food item. In response to ODCSLOG concerns, scientists and graphic artists from NRDEC and WHO formed a team to design a "Do Not Eat" symbol for the FRH. The wordless symbol, also known as a pictogram, was assessed by WHO for universal understandability (Figure 1). WHO's assessment revealed that the pictogram would help to prevent accidental ingestion of the FRH, and would properly ensure the safety of humanitarian aid recipients of MREs containing FRHs in even the most rural areas of the world. The U.S. Armed Service representatives ultimately concurred with the design, and FRHs were printed with the "Do Not Eat" pictogram beginning in September 1993 for inclusion in MRE XIII.



Figure 1.
"Do Not Eat" Pictogram for the FRH

This example of customer focus by NRDEC prompted a representative from the U.S. Naval Supply Systems Command (NAVSUP) to request NRDEC's assistance with the design of a Navy pictogram to identify marine degradable items. Beginning in January 1999, the Navy will be ordered to comply with Marine Pollution (MARPOL) Treaty regulations, which will prevent all overboard dumping of dry plastic and food-contaminated plastic waste.¹ As a result

of the Navy's Plastics Removal in a Marine Environment (PRIME) Program and the Army's Biodegradable Packaging Program, many disposable plastic items have been replaced, or are designated for replacement, with non-plastic items designed to degrade in a marine environment. Seawater degradable items developed under these programs, some of which are currently being tested, include hot/cold beverage paper cups, utensils, galley bags and meat wraps. Because these products often resemble the plastic items they are meant to replace, a need was identified for an internationally acceptable method of marking these items as being degradable and non-harmful to marine life. Without this identification, the Navy predicts there will be confusion both on board Navy ships in terms of separation, and with U.S. Coast Guard (USCG) officials who enforce dumping regulations and whose investigations may result in court-imposed fines.

NRDEC accepted NAVSUP's challenge and established a team to design the pictogram for marine degradable items, first for Navy and USCG use, and later for possible use by commercial vessels in international waters. The team was comprised of representatives from NRDEC, WHO and NAVSUP. NRDEC's efforts were funded by NAVSUP.

DEVELOPMENTAL STRATEGY

The NRDEC team initially met in June 1994 to develop a strategy which would result in a pictogram that would meet NAVSUP's needs. The team's goal was to design a pictogram that incorporates the criteria for use and understandability set forth by NAVSUP and WHO, that could be applied to a wide range of marine degradable items, and that sailors perceive as acceptable and clearly communicating marine degradability. The strategy was outlined as follows: define customer requirements; review WHO standards for universal understandability; graphically design pictogram prototypes; assess preliminary prototypes; conduct focus group studies; and conduct user test and evaluation of final pictogram. The final pictogram would be coordinated with NAVSUP for approval and subsequent application. Although NAVSUP did not provide a target date for completion, the team's goal was to accomplish these tasks within a six-month period to provide NAVSUP a pictogram by the end of December 1994. The NAVSUP representative approved of the team's aggressive strategy.

Customer Requirements

The purpose of the pictogram was to identify Navy items which appear to be plastic, but are actually non-plastic, marine degradable items. NAVSUP stated that their short-term goal is to use the pictogram as a U.S. Navy-specific identification aid, and to develop a method for obtaining authorization to include the pictogram in contracts and possibly the specifications for items of supply. The pictogram would identify degradable items to shipboard personnel for separation and disposal procedures. NAVSUP's long-term goal is to get the pictogram's use and recognition institutionalized in public law or USCG regulations in order to identify seawater disposable trash to USCG vessels which monitor the practice of overboard dumping.¹ Ultimately, the pictogram may be used in international waters by commercial and foreign vessels and monitoring agencies. NAVSUP provided the NRDEC team with the following list of requirements that the pictogram must meet: 1) a single pictogram must be designed for direct application to varying sizes of individual marine degradable items in supply, such as hot drink cups, bags, flatware, wiping towels and milk bladders; 2) the pictogram for extremely small items could be applied to the cases or cartons of items for shipboard identification purposes, then disposed of overboard in bags identified with the pictogram; 3) the pictogram must remain on the item for the same length of time that the item remains in its solid state; and 4) in all correspondence, the term "marine degradable" should be used in lieu of "ocean degradable" to comply with the terminology used in the Navy's PRIME Program and the MARPOL Treaty. At the completion of the project, NRDEC would provide NAVSUP with the final pictogram design with recommendations for its application to supply items.

World Health Organization Criteria

During the FRH pictogram development it was discovered that there is no standardizing organization which regulates the design parameters or usage of pictograms. However, WHO has

vast experience with assessing pictograms for universal understandability, and their resources were made readily available to our team. Scientists and graphic artists from WHO's Food Safety Unit agreed to review NRDEC's designs, provide recommendations, and assess the designs for understandability within their organization and externally, if requested. For development of the Navy pictogram, WHO suggested that NRDEC initiate several prototype designs and submit them to WHO for their internal review and assessment. In turn, WHO provided beneficial suggestions and suggested design modifications from an international perspective.

Graphic Design

The team's strategy was to design seven prototype pictograms for preliminary assessments by WHO, NAVSUP and NRDEC personnel. Several ideas were generated to assist the team's graphic artist. All agreed that the design had to be simple and broad enough to be applied in various sizes to any individual item. One suggestion was to use a dual-symbol approach, whereby a small simple symbol would be designed for small items, such as flatware, and a more detailed pictogram designed for large items. The user would be instructed to recognize the smaller symbol as a representation of the larger, more informative one. However, this idea was eliminated due to NAVSUP's requirement that one universal symbol be applicable to all items. Another idea was to utilize a triangular chasing arrow symbol similar to the common recycling triangle, except identified with a 'B' in the center. Although WHO believed the recycling triangle was used universally, they believed using the triangle would require the population to be educated as to its meaning. NAVSUP also warned that the recycling triangle implies that the item will be 'reused' at some point, and not biodegrade. Ideas that were eventually incorporated into the prototype designs included symbols depicting waves, fish, sea lions or seals, the PRIME logo seal, boats and degrading trash (Figure 2). Although not represented in this report, the objects in the pictograms were brightly colored in blue and green hues.

Preliminary Prototype Assessments

The seven prototypes were assessed concurrently by WHO, NAVSUP and NRDEC employees. WHO's internal review of the prototypes from an international perspective resulted in the following recommendations: Pictograms that are associated with a 'do' command, such as 'do throw item in ocean' in this case, are generally enclosed in a square border. In some cultures, circular pictograms are associated with 'do not' even without the conventional diagonal red line. Also, since colored pictograms are less reproducible and costly, only black and white ink should be used.² WHO suggested that seals or sea lions should not be depicted, since they are not found in all bodies of water. Instead, they recommended the more commonly found dolphin be used and provided several design prototypes (Figure 3).

NAVSUP's internal review resulted in the following suggestions: degrading trash depicted as circles preferred over diamonds; the fish should not appear too happy or eager so as to indicate it is anticipating something good is being fed to it (i.e., do not want trash to be

construed as being nutritious to marine life); and overall preferred draft number seven of Figure 2 because it incorporated a hand, down arrow, waves and circular trash.

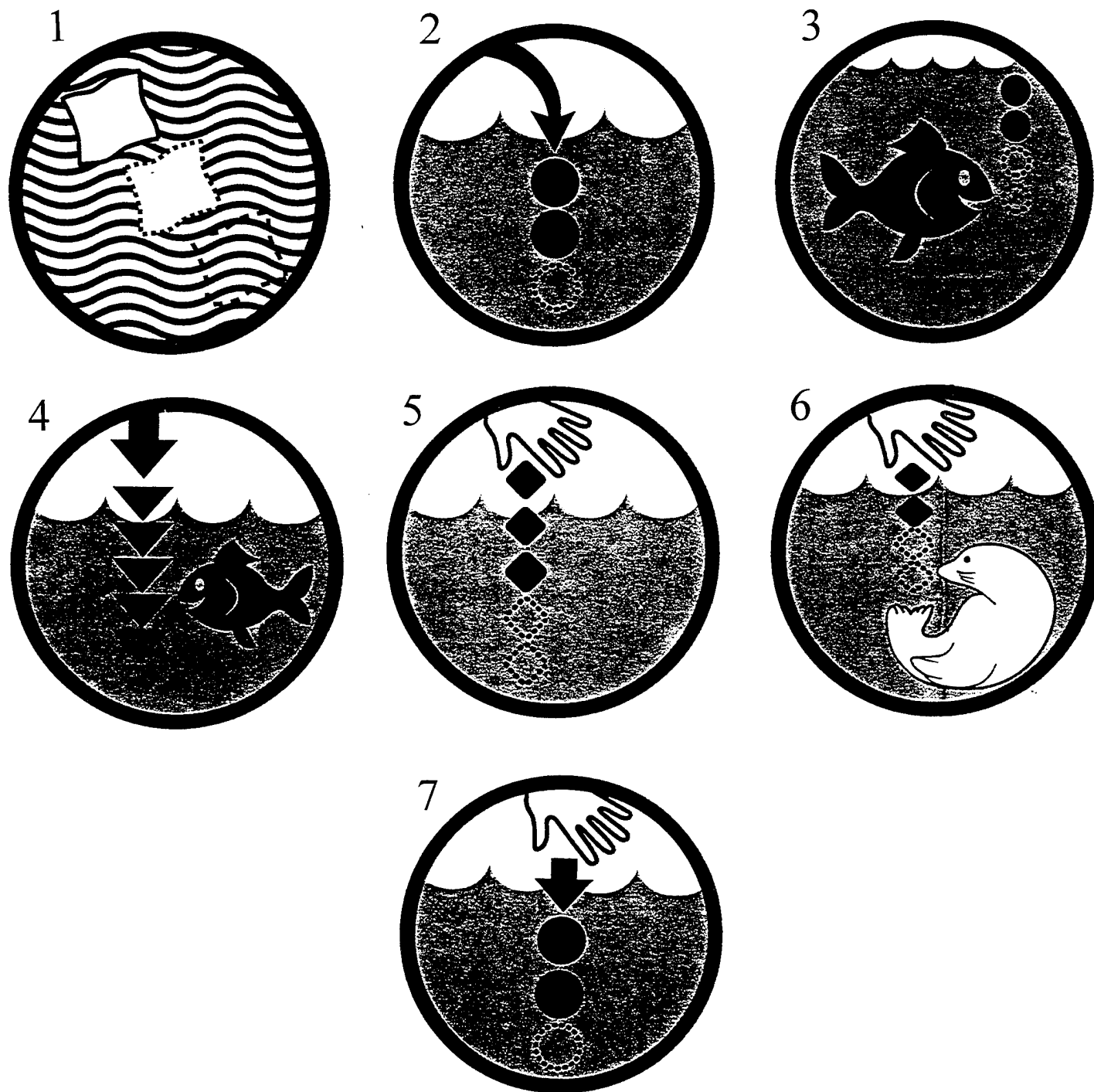


Figure 2.
Prototype Pictograms for Preliminary Assessments

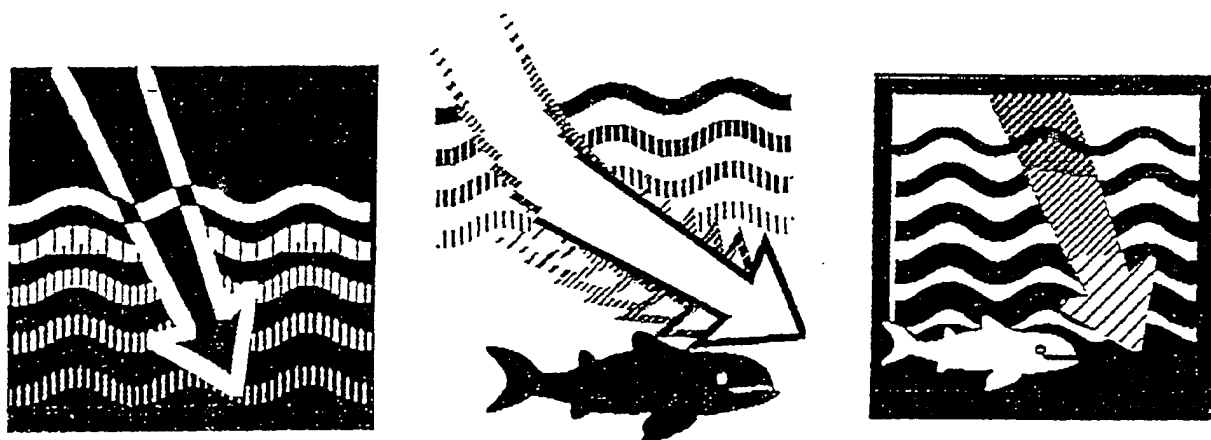


Figure 3.
WHO Prototype Pictograms

The consensus of the NRDEC survey on the pictograms shown in Figure 2 was to combine the depictions of the happy fish in the ocean, the circular trash, and the hand to show that a human is actually throwing trash into the ocean.³

After reviewing the above assessments, the team agreed on three 'semi-final' pictograms which incorporated most of the suggestions from the preliminary reviews. These three designs were submitted to WHO for internal review, and were evaluated by NRDEC's behavioral scientists in a series of focus group studies. The results of WHO's review and the focus group studies are outlined below. All three pictograms incorporated a square border, black and white ink, a wave line depicting the ocean, and a hand disposing of the trash (Figure 4). The designs varied in terms of the marine life depicted (dolphin vs. fish), and the objects which depicted degrading trash (circles vs. square vs. arrow only).

WHO Review

WHO believed all three prototypes successfully incorporated important universal symbols for human (hand), ocean (waves) and marine environment (fish/dolphin) necessary to convey the message. They offered the following beneficial suggestions: design components should be more discernable so they will show up on a small scale; make hand more prominent by lowering the wave line; and make a clearer expression on the face of the dolphin.⁴

Focus Group Studies

Two focus groups were conducted to gather sailors' responses to each design shown in Figure 4, which differed in design and symbols used to convey degradability. One group was conducted with 21 sailors on board the USS Bainbridge at the Naval Air Station in Norfolk, VA on 9 November 1994, and the other group was composed of 20 sailors at the Naval Station at Newport, RI on 15 November 1994.

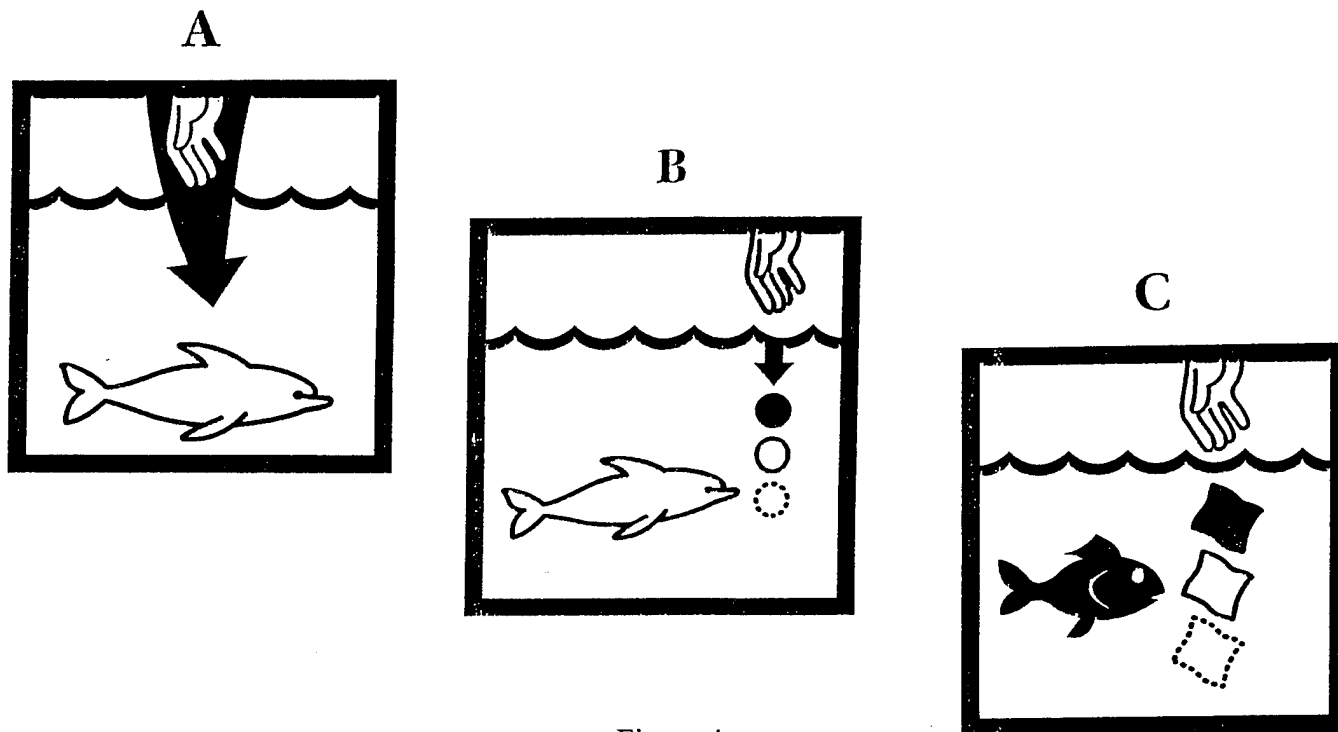


Figure 4.
Focus Group Prototype Pictograms

Method

The focus group participants were told the purpose of the pictogram, i.e., to facilitate identification of marine degradable items. They were then shown the three prototype pictograms individually. For each one, participants were asked the following questions:

1. Is there anything you like about this pictogram? If so, what?
2. Is there anything you dislike about this pictogram? If so, what?

3. You know the purpose of this pictogram, i.e., that we are trying to convey that an item marked by this pictogram could be discarded into the ocean without harming marine life. Do you think that, if this pictogram were put on the item, it would send the message to sailors that they could dispose of the item into the ocean?

Participants were also asked their opinions about the different symbols used in the prototype pictograms. For example, comments were elicited regarding the dolphin in Pictograms A and B versus the fish in Pictogram C and the circles in Pictogram B versus the squares in Pictogram C. Finally, participants were asked if they believed training would help sailors understand the meaning of the pictogram and how it will be used, and, if so, what types of training would be most effective.

When the participants were finished discussing the pictograms, they were presented with a short questionnaire (Appendix A). First, they rank ordered the three pictograms in terms of how much they liked each one. A rank of "1st" indicated they liked that pictogram the best, while a rank of "3rd" indicated that they liked that pictogram the least. They then rated how much they liked each pictogram individually on a five-point scale with 1 = Do not like at all and 5 = Like very much.

Next, the participants rank ordered the pictograms in terms of how well each one would send the message that an item (e.g., a paper cup or disposable utensil) is marine degradable. A rank of "1st" indicated that the pictogram was the best at conveying the information, while a rank of "3rd" indicated that the pictogram was the worst at conveying the information. They then rated how well each pictogram individually would send the message that an item is marine degradable using a five-point scale with 1 = Very poorly and 5 = Very well.

Results

A summary of comments made about the three prototype pictograms during the focus group discussions is displayed in Table 1. Participants expressed some confusion about the message conveyed by Pictogram A (e.g., throw the item in the ocean vs. don't throw the item in the ocean). In contrast, responses to Pictograms B and C were more favorable. The addition of the circles/squares breaking down was cited as increasing the pictograms' ability to communicate degradability. However, there were still some comments that indicated confusion (e.g., for Pictograms A and B - "Don't throw in" message - it's the fish's environment).

Table 1. Focus Group Discussion Comments on Prototype Pictograms

Prototype Pictogram A

- Gives the impression that it's ok to throw into the ocean
- Looks like you're feeding the dolphin
- Looks like the fish is going to eat the hand
- It's the fish's environment; Don't throw anything in
- Isn't self-explanatory
- Doesn't say you can throw trash in
- Hand says you can throw it overboard
- Where's the trash
- This one is good. The arrow says you can throw the trash in.

Table 1. Focus Group Discussion Comments on Prototype Pictograms
(Continued)

Prototype Pictogram B

- This one is better
- Adding the circles makes it more understandable - throw in things and they break down
- "Don't throw in" message - It's the fish's environment
- Looks like the fish will eat it
- This is better than A
- Says it's to throw overboard
- What does the circle mean?
- Need an actual picture of trash. The circle isn't recognizable.
- Looks like dolphin will eat the trash
- The outline of the breaking down trash is good

Prototype Pictogram C

- It's the same as Pictogram B
- Most like dolphin in Pictos A and B better than fish of Pictogram C
- Dolphin is more popular than fish
- Dark fish in Pictogram C is more noticeable
- Diamonds/squares look like paper/trash/napkins.
- The circles in Pictogram B look like cups.
- Will there be different symbols on different items?
- This one is the most self-explanatory
- The squares look like trash
- The squares are better than the circles
- The fish is better than dolphin. Shows that items are safe for any kind of fish, not just dolphins.
- Can dolphin in B be made dark like fish in C?
- Fish looks happier than dolphin

An examination of the rank-order and rating data also indicates that Pictograms B and C were viewed more positively than Pictogram A. As Figure 5 shows, the percentage of participants who ranked Pictogram B and Pictogram C "1st" (i.e., liked best) was greater than the percentage who ranked Pictogram A "1st". Compared to Pictograms B and C, Pictogram A was ranked "3rd" (i.e., liked least) by the largest percentage of participants. The percentages of participants ranking Pictogram B and Pictogram C "1st", "2nd" and "3rd" were identical.

Mean liking ratings for the three prototype pictograms are found in Table 2. Only the mean rating of Pictogram C is above 3.00 on the five-point scale, indicating at least a moderate degree of liking. A repeated measures multivariate analysis of variance (MANOVA) and post-hoc comparisons revealed that ratings for the three pictograms were significantly different ($F[2,74] = 7.07, p < .002$), with both Pictogram B and Pictogram C being liked more than

Pictogram A. Ratings for Pictogram B and Pictogram C did not differ significantly ($p>0.05$).

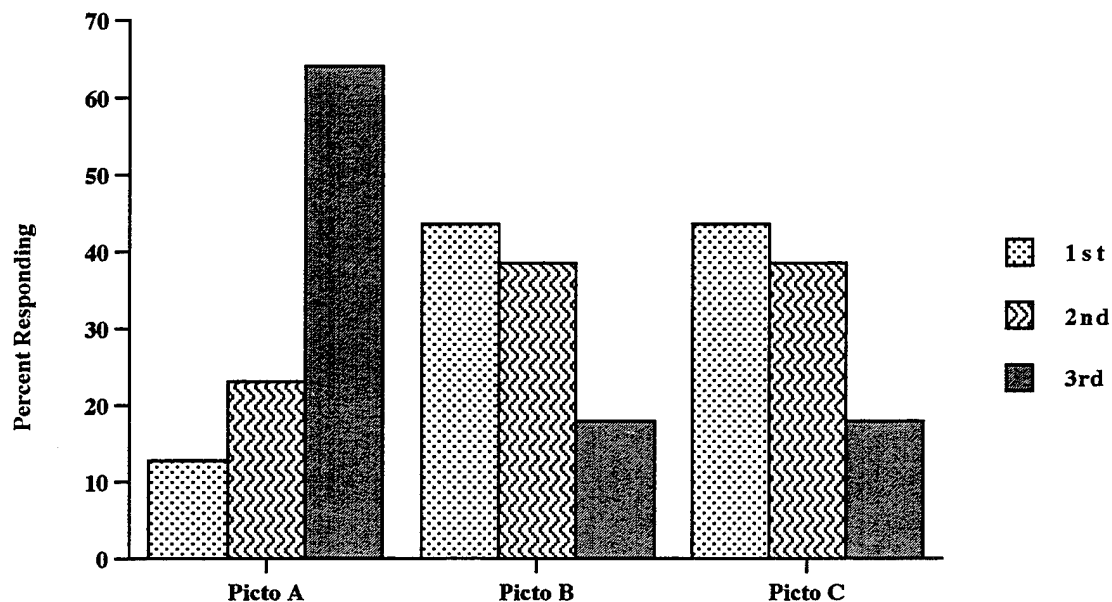


Figure 5

Summary of Sailors' Responses to the Following: "Considering all three Pictograms together, rank them in terms of which one you like best."
(1st = the one you like best; 3rd = the one you like least)

Table 2. Summary of Sailors' Responses to the Question
"How much do you like this Pictogram" for Prototype Pictograms A-C?
Percent Responding with Each Rating: 1=Do Not Like At All; 5= Like Very Much

	Mean (SD)	1	2	3	4	5
Prototype Pictogram A	2.18 (1.22)	42.5	17.5	22.5	15.5	2.5
Prototype Pictogram B	2.83 (1.39)	22.5	22.5	20.0	20.0	15.0
Prototype Pictogram C	3.05 (1.32)	15.0	20.0	27.5	20.0	17.5

There were also differences in how well participants believed that the prototype pictograms communicated marine degradability. Figure 6 shows that the percentage of participants who ranked Pictograms B and C "1st" in terms of how well they convey marine degradability is greater than the percentage who ranked A "1st". Slightly more participants (46.2%) ranked Pictogram C "1st" than Pictogram B (41%). Compared to the other two prototype pictograms, Pictogram B was ranked "2nd" by the greatest percentage of participants, while Pictogram A was ranked "3rd" (worst) by the largest percentage.

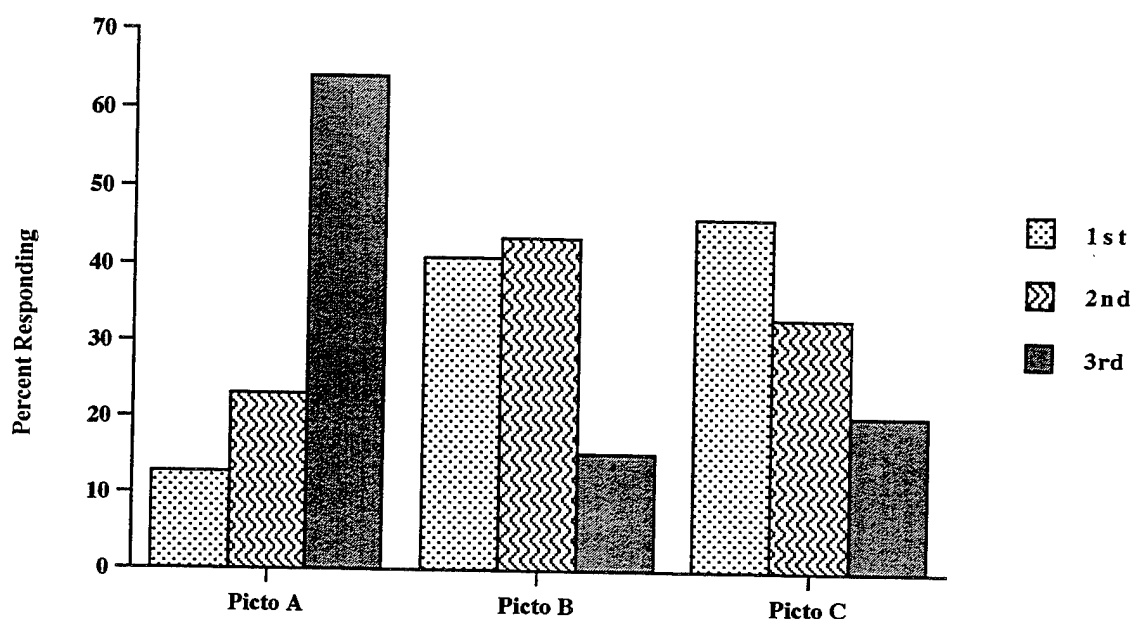


Figure 6.

Summary of Sailors' Responses to the Following:

"Considering all three pictograms together, rank them in terms of which one would best send the message that an item is marine degradable."

(1st = the one that does this the best; 3rd = the one that does this the worst)

Mean ratings of how well/poorly each prototype pictogram would convey that an item was marine degradable are found in Table 3. A repeated measures MANOVA revealed that ratings for the three pictograms were significantly different ($F[2,74] = 7.02, p < .002$), while post-hoc comparisons showed that both Pictogram B and Pictogram C were perceived as better than Pictogram A at communicating degradability. There were no significant differences in ratings between Pictogram B and Pictogram C.

Table 4 summarizes miscellaneous comments made in the discussion related to the pictogram. In general, participants believed that the design of the pictograms should be made simpler. For example, many proposed a single symbol (e.g., a green dot, a fish) or a word (e.g.,

"safe", "biodegradable") to denote degradability. The participants also recommended that some sort of training (e.g., posters, ads in Navy magazines) accompany the placement of the pictogram on items to explain the meaning of the pictogram and how it will affect waste separation and disposal.

Table 3. Summary of Sailors' Responses to the Question "How well would this pictogram send the message that an item is marine degradable?" for Prototype Pictograms A-C
Percent Responding with Each Rating: 1=Very Poorly; 5=Very Very Well

	Mean (SD)	1	2	3	4	5
Prototype Pictogram A	2.30 (1.20)	35.0	22.5	22.5	17.5	2.5
Prototype Pictogram B	3.25 (1.28)	10.0	20.0	25.0	25.0	20.0
Prototype Pictogram C	3.23 (1.33)	12.5	20.0	20.0	27.5	20.0

Table 4. Miscellaneous Comments from Focus Group Discussions

USS Bainbridge, Norfolk, VA - 9 November 1994

- Use words - why not print degradable on items?
- Color code - green sticker means "throw in"; red sticker means don't
- Why a puzzle?
- Training is needed to teach sailors what Pictogram means
- Poster could be used as training, but poster would not last long on the ship

Naval Station, Newport, RI - 15 November 1994

- Design needs to be simpler
- Use just a fish
- Use a stop sign just like when driving to say "don't throw it in" and a green sign to say "throw it in"

Table 4. Miscellaneous Comments from Focus Group Discussions
(Continued)

- Just write "biodegradable" or "safe" on products
- Sailors will need training
- Advertise logo in Navy Magazines like "All Hands"

Discussion and Recommendations

Pictograms B and C were viewed more favorably than Pictogram A. Moreover, there were few differences in responses to Pictograms B and C. An examination of the comments in Table 1 indicates that participants liked specific aspects of these two prototypes. For example, they were generally more positive toward the use of the degrading squares in Pictogram C than the degrading circles in Pictogram B. Similarly, the dolphin in Pictogram B was generally regarded more favorably than the fish in Pictogram C. Based on these comments, it was recommended that the final pictogram combine these aspects of Pictograms B and C. This combination was anticipated to improve sailors' liking for the pictogram, as well as its ability to connote marine degradability, since ratings on these aspects of the prototype pictograms were only moderate in these focus groups. Several sailors also indicated that the darker fish in Pictogram C was more noticeable and that it appeared "happier" than the dolphin. Modifications to the dolphin based on these and WHO's comments were anticipated to improve the visibility of the pictogram on a small scale.

Focus group discussions also suggested that some form of brief training be made available to aid sailors in understanding the meaning of the final pictogram. In both focus groups, sailors indicated that the design of the pictogram should be simpler, e.g., a single symbol or word. Although these suggestions are valuable, criteria for international understandability set forth by WHO precluded their implementation. However, because these concerns were raised in both focus groups, training to accompany the final pictogram might address why certain aspects of the design were included to facilitate international understanding.

User Test and Evaluation of Final Pictogram

Part of NRDEC's strategy was to utilize focus group results to modify and finalize the pictogram design and then to test and evaluate sailors' perception of the final pictogram in the context in which it will be used. Based on the results of the focus groups and WHO's evaluation of the prototypes, the team designed the final pictogram (Figure 7). This pictogram was stamped on biodegradable beverage cups for use in a shipboard user test and evaluation of the pictogram concept. A summary of the user test and evaluation of the final design is outlined below.

Method

The final pictogram, shown in Figure 7, was evaluated in conjunction with a user test of biodegradable beverage cups at the U.S. Naval Station at Norfolk, VA. Three hundred twenty-nine sailors participated in the test on board the USS Mount Whitney (n=163) on 7 December 1994 and on board USS Barry (n=166) on 8 December 1994. The glassware typically used at meals was replaced by the test beverage cups for one lunch meal. Sailors received their meal and took a test cup. Two types of biodegradable cups were evaluated. One was the all-paper cup currently in the naval supply system. The second cup was paper lined with a biodegradable material developed by Zeneca, called Biopol™. In testing, this item was referred to as the Biopol™ cup.

In order for both cups to be independently tested on each ship, the evaluation session was divided into two phases. Sailors participating in the first half of the test evaluated one type of cup, while those participating in the second half tested the other cup. The all-paper cup was presented in the first half of the test on board USS Mount Whitney; the Biopol™ cup was tested during the second half. The order of presentation was reversed on USS Barry. One hundred sixty-two sailors tested the all-paper cup, while 167 tested the Biopol™ cup. Sailors received no information about the type of cup they were evaluating (results of the beverage cup evaluation are not within the context of this report).

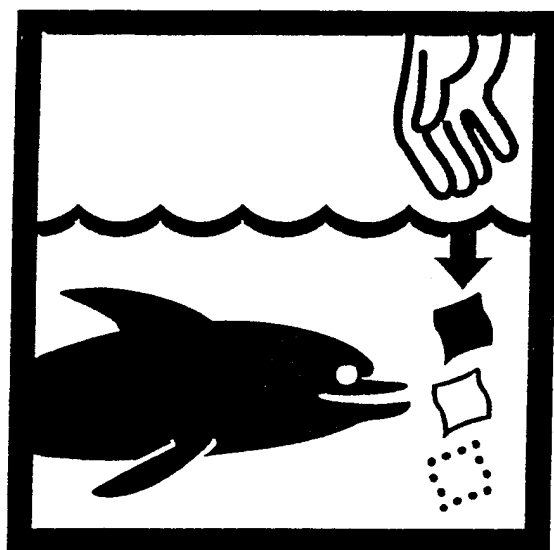


Figure 7.
Final Pictogram for Marine Degradable Items

The pictogram was manually stamped on each cup with a non-toxic, water soluble ink. In an effort to determine the best place for application of the final pictogram, the location of the stamp was varied. On half, the stamp was located on the exterior bottom of

the cup. On the other half, the stamp was placed on the exterior side of the cup approximately 1-1/4 inches from the rim. Each ship received the same number of cups with the pictogram stamped in each location. Sailors selected the cups randomly. One hundred sixty-four sailors evaluated the pictogram on the bottom of the cup, while 160 tested it on the side (five sailors did not indicate where the pictogram appeared on the cup).

Once sailors received the test cup, an experimenter presented them with a short questionnaire (Appendix B). Sailors were instructed to use the cup to drink their beverage and then complete the questionnaire. To ensure that the pictogram could be easily examined by the sailors, it was stamped on each questionnaire as well as on the cups. The questionnaire began with information deemed necessary for sailors to evaluate the pictogram. The information included a statement about the purpose of the pictogram. This statement was included to focus sailors' attention on the intended meaning of the pictogram, rather than have them guess at its meaning and then evaluate the pictogram's effectiveness. The following information was presented:

The cup you are using is stamped with a picture logo called a PICTOGRAM either on the side of the cup or on the bottom of it. A copy is also displayed below. The purpose of the PICTOGRAM is to identify Navy items that can be safely disposed of at sea. The PICTOGRAM has been applied to the cups you are testing today with a non-toxic, water soluble ink. In the future, sailors will receive training on the purpose and proper usage of the PICTOGRAM.⁵

This statement was followed by a series of questions. Although the acceptability and performance of the cup were evaluated, sailors' reactions only to the pictogram were of interest here. Questions regarding the pictogram included the following:

1. Where is the pictogram located on the cup that you are using? (On the side of the cup or on the bottom of the cup - Choose one)

2. Knowing the purpose of the pictogram, how poorly/well does it send the message that this cup can be safely disposed of at sea without harming the marine environment? (Responses were made on a five-point scale with 1 = very poorly and 5 = very well.)

3. How much do you like the pictogram? (Responses were made on a five-point scale with 1 = do not like very well and 5 = like very much.)

4. The fourth question asked sailors which of a series of methods would be effective ways for the Navy to inform them about the purpose and proper usage of the pictogram. Sailors could choose as many of the following options as they wished: posters hung on board ship; ads in Navy magazines; Quarters (a daily meeting); brief classroom training; and Plan-of-the-Day (a written summary of the day's events). They could also write in an additional method they believed would be effective that was not listed.⁵ The final question was an open-ended one asking sailors to provide any other comments they had about the pictogram.

Results

Sailors' ratings on the ability of the pictogram to convey that an item is marine degradable as well as its likability are presented in Table 5. Mean ratings for each question were subjected to a 2 X 2 X 2 analysis of variance (ANOVA) to determine whether differences existed based on the ship where the evaluation occurred (Mount Whitney vs. Barry), the type of cup tested (all-paper vs. Biopol™), and the location of the pictogram on the cup (bottom vs. side).

Responses to the question about the pictogram's ability to convey that an item is marine degradable are displayed in the upper half of Table 5. As this table shows, sailors believed that the pictogram connoted degradability fairly well (mean = 3.96, sd = 1.13). Moreover, 68.7% of the sailors gave the pictogram a rating of 4 or 5, while only about 9.2% evaluated the pictogram with a rating of 1 or 2 (1 = very poorly; 5 = very well). Ratings did not differ by type of cup or by ship. However, the pictogram stamped on the side of the cup was seen as conveying the message better (mean = 4.11) than the pictogram located on the bottom (mean = 3.80 - $F[1,319] = 5.99, p < .015$). In addition, there were no significant interactions among cup type, ship and location of the pictogram on the cup.

Perceptions of the likability of the pictogram are found in the lower half of Table 5. On the average, sailors expressed some liking for the pictogram (mean = 3.63; sd = 1.07). Almost 53% (52.6%) gave it a rating of 4 or 5 (1 = do not like at all; 5 = like very much). In contrast, only about 9.8% rated it at 1 or 2. Responses did not differ by the type of cup or by the location of the pictogram on the cup, but sailors on board USS Mount Whitney liked the pictogram more (mean = 3.77) than those on board USS Barry (mean = 3.49 - $F[1,319] = 5.60, p < .019$). None of the interactions reached significance.

Table 5. Summary of Sailors' Responses to Questions about the Ability of the Pictogram to Convey Degradability and the Likability of the Pictogram
Percent Responding with Each Rating: 1=Very Poorly; 5=Very Well

Knowing the purpose of the pictogram, how poorly/well does it send the message that this cup can be safely disposed of at sea without harming the marine environment?

Mean (SD)	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>
3.96 (1.13)	5.2	4.0	22.1	27.0	41.7

How much do you like the pictogram?

Mean (SD)	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>
3.63 (1.07)	5.2	4.6	36.8	27.7	24.9

Sailors were also asked which of several methods would effectively communicate the purpose and proper usage of the pictogram. The percentage responding with each method is presented in Figure 8. Using posters on board ship was endorsed by the largest percentage of sailors (52.3%), followed by Plan-of-the-Day (50.8%) and Quarters (31.9%). About 6% (5.8%) of the sailors listed additional methods. These methods, displayed in Table 6, are diverse, ranging from an "Ad on tables in messdecks" to making sure sailors "understand it (the pictogram) before they go on liberty". The use of television/video was the most frequently suggested additional method.

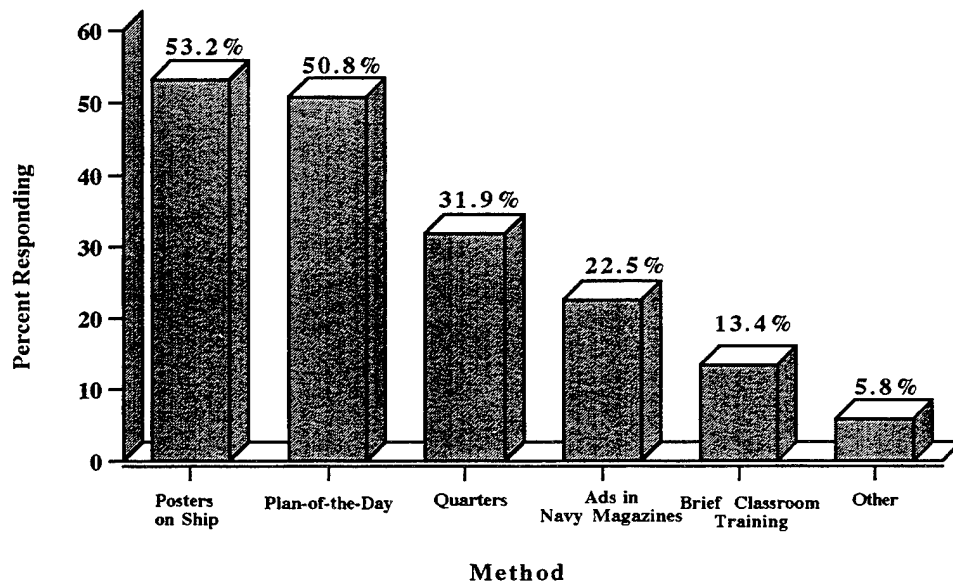


Figure 8.

Summary of Sailors' Responses to the Following:

"Which of the following methods would be effective ways for the Navy to inform sailors about the purpose and proper usage of the pictogram?"

Table 6. Additional Methods Listed by Sailors to Communicate the Purpose And Proper Usage Of Pictogram

Commanding Officer on IMC (Microphone)	Lunch
TV/Commercial	Video presentations
Common Sense	Site TV
Ads in Navy Newspaper	Mail
Ads in Tables in Messdecks	Put it on the cup
Make sure they understand it before they go on liberty	Reading

Table 7 presents a summary of sailors' comments about the pictogram in response to the open-ended question 'Please add any additional comments you may have about the pictogram'. Of the 329 respondents, 48 (14.6%) commented specifically about the pictogram. (Eight responses [2.4%] were made about the cups. These will be examined in a separate report on the beverage cup evaluation.) Many of these 48 remarks (31.3%) were positive about the effort. Others (50%) suggested aesthetic improvements, such as increasing the size of the pictogram on the cup, placing it on the side of the cup rather than on the bottom, and including words with it to increase its understandability. Most comments about the effort to create the pictogram and about the pictogram itself were positive.

Table 7. Comments about the Pictogram^a

1. General Positive Comments - 31.3%

- Great idea!
- Very pleased to see such action & emphasis placed on saving the environment!
- I think this is a very good program, because separating trash is a big thing when we're at sea. It will make it easier and less time will have to be spent re-separating trash.
- I think this is an excellent idea to keep our waters free of waste that would harm the animals in the sea.

2. Comments about Aesthetics - 50%

Location (8.3%): All 4 comments said the pictogram should be on the side of the cup.

Size (8.3%): All 4 comments said the pictogram should be bigger or is not big enough.

Include words with picture or to explain picture (12.5%)

- Maybe say above pictogram "safe for ocean disposal."
- Choose a strong word to stress your message.
- How about using words instead of a hieroglyphic that must be deciphered. Example: "This cup is biodegradable" or "You can safely throw this cup into the ocean."

Dolphin (8.3%)

- Makes you think we're feeding the dolphins paper cups
- Good choice. Dolphins are cool.

Other Comments about Aesthetics (12.5%)

- Maybe change color for a brighter one.

Table 7. Comments about the Pictogram^a
(Continued)

- The picture of the pictogram could be more defined.
- Better art work.
- Pictogram shows trash items put into the sea. It shows a marine animal near it. This makes you think it can be eaten by marine animal. I think it would be better to indicate by a pictogram if an item can just be put into the sea.
- Less ink would make it less expensive.
- Improve drawing.

3. Other Comments about the Pictogram - 18.8%

- Use it on bigger cups
- Did not know what the stamp meant when I first saw it
- How long would it take for the cup to dissolve
- Knew what it indicated before I was told its meaning. It's a very simple pictogram that gets its meaning across.
- What about land recycling programs?
- I'm not overly concerned about the marine environment.
- It's message is not clear without training as mentioned above.
- I think people know what is paper or plastic and can be put over the side. No pictograph, no matter what size, color, or the picture, is going to change a lazy sailors attitudes about throwing stuff over.
- Promotes littering.

^a Coding Category - Percentage of Sailors Making Response

Discussion and Recommendations

This study tested a pictogram designed from combining the favorable aspects of two prototype pictograms from focus group studies described previously. These changes in design proved to have a positive impact on sailors' attitudes. In general, they liked the new pictogram and believed that it would convey the message that an item is marine degradable. Moreover, many of the comments made about the pictogram in response to an open-ended question were also positive. The impact of the type of cup tested, the location of the pictogram on the cup, and the ship on which the cup was tested was also examined. Whether the cup was all-paper or lined with Biopol™ did not significantly affect responses. However, sailors on board USS Mount Whitney liked the pictogram more than those on USS Barry. In addition, the pictogram stamped on the side of the cup was perceived to better communicate degradability than one stamped on the bottom of the cup, probably because it was easier to view. Comments made in response to the open-ended question also supported the placement of the pictogram on the side.

Several training modes to instruct sailors about the pictogram were also evaluated in this study. Posters on board ship and plan-of-the-day were endorsed as effective means of communication by the largest percentages of sailors.

CONCLUSIONS AND RECOMMENDATIONS

Coordination and Approval

The results of NRDEC's user evaluations supported the adoption of the final pictogram to facilitate identification of marine degradable products. In addition, results of WHO's internal assessment indicated that the pictogram would be understood in international waters. NAVSUP representatives were briefed on NRDEC's findings and were provided with copies of focus group and user test results. In December 1994, NAVSUP approved the final design and requested NRDEC's recommendations on application methods.

Application

The pictogram would be best applied to most individual target items identified by NAVSUP. Application of the pictogram should occur during the manufacture of the item, and should be applied with non-toxic, food-grade degradable black ink. The requirement that the pictogram remain on the item for as long as the item remain in its solid state should be included in Navy specifications in the form of a performance test.

The final pictogram may be directly applied in varying sizes to individual Navy supply items as required. Results from NRDEC's user studies suggest that, no matter what product the pictogram is applied to, it should be located and printed in a way that is clearly visible to the user. This would maximize the utility of the pictogram as a means of identifying marine degradables and facilitating waste separation and disposal. However, there may be situations where this is not possible. For example, items like flatware may be too small to apply the pictogram directly on them. In these cases, NAVSUP intends to place the pictogram on cases or cartons containing items rather than on the item itself. The pictogram on the carton would still inform shipboard personnel that the flatware is degradable and could be disposed of in degradable trash bags identified with the pictogram. Another option to identify the degradability of very small items such as flatware may be to incorporate a food grade pigment (blue or green) into the utensil while it is being manufactured. This method was suggested by Royal Maid Association for the Blind, Incorporated, a company that currently manufactures flatware for the Armed Services. The only disadvantage of this method is that Navy and Coast Guard personnel would have to be trained on the meaning of pigmented items.

For items such as degradable beverage cups, user study results indicated that the pictogram stamped on the exterior side of the cup was perceived to communicate degradability better than one stamped on the exterior bottom of the cup, probably because it was more visible. Comments made in response to open-ended questions also supported the placement of the pictogram on the side. In addition, it is more cost-effective to print the pictogram on the side-board material during its manufacturing process than on the bottom board. The bottoms of Biopol™ cups are also coated on both sides to secure a bottom seal, which prevents conventional types of ink from adhering to

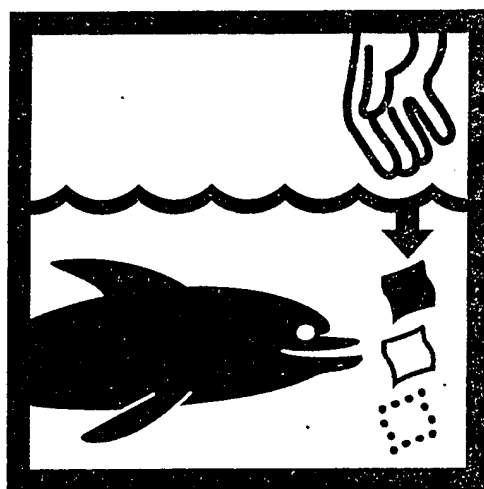
the surface. Cup manufacturers indicated that printing of side-board material would not add to the cost of the cup.

Training

Although WHO's assessment of the pictogram indicates that it should be understood by all populations, U.S. Navy personnel who evaluated the pictogram suggested that initial training on the purpose and meaning of the pictogram would still be beneficial. Therefore, NRDEC's study questionnaires included a survey on preferred training modes to instruct sailors about the pictogram. Posters on board ship and plan-of-the-day pamphlets were endorsed as effective means of communication by the largest percentages of sailors.

Pictogrammed items initially used on board Navy ships should be accompanied by a poster that identifies the pictogram and includes a few words or a slogan to instruct sailors about its purpose. Also, because many sailors supported the use of plan-of-the-day pamphlets in this study, information about the pictogram that could not be included on the poster due to space constraints could be disseminated through this method. Since several sailors in the studies suggested that words replace or be included with the pictogram, some information about the fact that the pictogram must be a wordless symbol that is internationally understood might be included. Training efforts like these will be beneficial in the initial phases of application. With time and consistent use of degradable items, sailors will become familiar with the pictogram and what it means for waste separation and disposal. Then, shipboard posters can serve primarily as reminders, and information can be passed informally among sailors by word-of-mouth communication.

Prior to obtaining necessary authorization to use the pictogram, NRDEC recommends that NAVSUP provide a copy of the training poster and a list of target items to USCG officials for their review.



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APPENDIXES

APPENDIX A

Focus Group Questionnaire

APPENDIX A

Considering all three pictograms together, rank them in terms of which one you like best. Write "1" on the line below next to the pictogram you like best, write "2" on the line next to the pictogram you like next, and write "3" on the line next to the pictogram you like least.

PICTO A _____

PICTO B _____

PICTO C _____

How much do you like PICTO A?

Do not like at all					Like very much
1	2	3	4	5	

How much do you like PICTO B?

Do not like at all					Like very much
1	2	3	4	5	

How much do you like PICTO C?

Do not like at all					Like very much
1	2	3	4	5	

Considering all three pictograms together again, rank them in terms of which one you think would best send the message that an item (for example, a cup or utensil) is marine degradable (i.e., could be thrown into the ocean without harming the marine environment). Write "1" on the line below next to the pictogram you think does this best, write "2" on the line next to the pictogram you think does this next best, and write "3" on the line next to the pictogram you think does this the least.

PICTO A _____

PICTO B _____

PICTO C _____

How poorly/well would PICTO A send the message that an item is marine degradable?

Very Poorly					Very Well
1	2	3	4	5	

How poorly/well would PICTO B send the message that an item is marine degradable?

Very Poorly					Very Well
1	2	3	4	5	

How poorly/well would PICTO C send the message that an item is marine degradable?

Very Poorly					Very Well
1	2	3	4	5	

APPENDIX B

Beverage Cup Evaluation Questionnaire

APPENDIX B

USER EVALUATION OF HOT/COLD BEVERAGE CUP

The U.S. Army Natick Research Development & Engineering Center and U.S. Naval Supply Systems Command is conducting an evaluation of a hot/cold beverage cup. Please use the cup in place of the cup/glass/mug you would normally use at this meal. Then answer the questions below. All of your responses will be kept confidential, so please answer as honestly as you can. Thank You.

Part I:

The cup you are using is stamped with a picture logo called a PICTOGRAM either on the side of the cup or on the bottom of it. A copy is also displayed below. The purpose of the pictogram is to identify Navy items that can be safely disposed of at sea. The PICTOGRAM has been applied to the cups you are testing today with a non-toxic, water soluble ink. In the future, sailors will receive training on the purpose and proper usage of the PICTOGRAM.



1. Where is the pictogram located on the cup you are using? (Chose only one)

☐ On the side of the cup

☐ On the bottom of the cup

2. Knowing the purpose of the pictogram, how Poorly/Well does it send the mesage that this cup can be safely disposed of at sea without harming the marine environment?

VERY
POORLY

VERY
WELL

1
☐

2
☐

3
☐

4
☐

5
☐

3. How much do like the pictogram?

DO NOT LIKE
AT ALL

LIKE
VERY MUCH

1
☐

2
☐

3
☐

4
☐

5
☐

4. Which of the following methods would be effective ways for the Navy to inform sailors about the purpose and proper usage of the pictogram? (Chose all that apply)

- ☐ Posters hung onboard ship
- ☐ Ads in Navy Magazines
- ☐ Quarters

- ☐ Brief classroom training
- ☐ Plan-of-the-day
- ☐ Other _____

5. Please add any additional comments you may have about the pictogram.

Part II. Please answer the following questions about the performance of the beverage cup.

	HOT BEVERAGE		COLD BEVERAGE	
Did you use the cup for a hot or cold beverage?	YES <input type="radio"/>	NO <input type="radio"/>	YES <input type="radio"/>	NO <input type="radio"/>
	If YES, COMPLETE COLUMN		If YES, COMPLETE COLUMN	
Did you refill the cup?	YES <input type="radio"/>	NO <input type="radio"/>	YES <input type="radio"/>	NO <input type="radio"/>
	Number of refills		Number of refills	
Did the cup maintain the temperature of the beverage?	YES <input type="radio"/>	NO <input type="radio"/>	YES <input type="radio"/>	NO <input type="radio"/>
Did the beverage seep through the cup?	YES <input type="radio"/>	NO <input type="radio"/>	YES <input type="radio"/>	NO <input type="radio"/>
Did the cup affect the taste of the beverage?	YES <input type="radio"/>	NO <input type="radio"/>	YES <input type="radio"/>	NO <input type="radio"/>
How long was the beverage in the cup?	<input type="radio"/> Less than 5 min <input type="radio"/> 5 - 10 min <input type="radio"/> more than 10 min		<input type="radio"/> Less than 5 min <input type="radio"/> 5 - 10 min <input type="radio"/> more than 10 min	
If given the opportunity, would you use this type of cup again?	YES <input type="radio"/>	NO <input type="radio"/>	YES <input type="radio"/>	NO <input type="radio"/>
While drinking a hot beverage, was the cup too hot to hold?	YES <input type="radio"/>	NO <input type="radio"/>		

Did you use the same cup for both a hot and cold beverage? ☐ YES ☐ NO

Please use the scale below to rate how easy/difficult it was to drink from the cup.

	VERY DIFFICULT	1	2	3	4	5	6	7	VERY EASY
HOT BEVERAGE	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
COLD BEVERAGE	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	

Please use the scale below to rate the sturdiness of the cup.

	NOT AT ALL STURDY	1	2	3	4	5	6	7	VERY STURDY
HOT BEVERAGE	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
COLD BEVERAGE	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	

Please use the scale below to rate how much you liked the cup for the beverage types you drank at this meal?

	DISLIKE VERY MUCH	1	2	3	4	5	6	7	LIKE VERY MUCH
HOT BEVERAGE	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
COLD BEVERAGE	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	

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