GEORGIA INSTITUTE OF TECHNOLOGY
Engineering Experiment Station
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FINAL REPORT

PROJECT A-940

INVESTIGATION OF PROPERTIES OF SEALED AND STORED GASOLINE

By

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FOREWORD

This project, as originally planned, consisted in evaluating the concept of packaging gasoline in pull-tab cans. Since the sponsor was unable to furnish the product in this form, it became necessary for us to undertake the procurement of suitable tins and the packaging of the product. Although this latter activity dominated the period of the research, the principle objectives were still met. Some of the information gained is of greater value in assessing the original concept than would have been the originally intended results.

The following persons contributed generously of their time, facilities, and/or supplies towards this activity, and we wish to express our gratitude to them for their assistance:

Mr. Bear, Alcoa, Atlanta, Georgia

Mr. Moss, Dekalb Cannery, Avondale, Georgia

Mr. Lamothe, Dewey & Almy Chemical Division, W. R. Grace & Company, Atlanta, Georgia

Mr. Couillou, American Can Company, Forest Park, Georgia

Mr. Teeter, Crown Cork & Seal Company, Atlanta, Georgia

Mr. Harry Hall, The Coca Cola Company, Atlanta, Georgia

ABSTRACT

The concept of packaging gasoline in pull-tab cans has been found to be subject to the following restrictions: can body and ends must be entirely of steel construction, except for the tab insert, which may be of aluminum. Seal around tab insert must be a solvent resistant material, such as polyester, epoxy, etc. End gasket seal must be of solvent resistant material, such as Neoprene. A maximum storage temperature of 165 degrees F should be contemplated. A maximum can size was not determined, but is estimated at 24 to 32 fluid ounces.

I. INTRODUCTION

The purpose of this research project was to investigate the feasibility of packaging gasoline in cans having pull-tab openers. Items that were to be included in the investigation were (1) leakage resulting from expansion and contraction due to thermal and pressure changes, (2) chemical changes occurring during anticipated shelf life, and (3) potential explosion hazards. The cans to be included were to be at least two of the following: 1 quart, $\frac{1}{2}$ gallon, and 1 gallon.

The sponsor was unable to make arrangements with any supplier of cans or petroleum products to have a suitable product suitably canned and delivered to us. For this reason, we were given the additional assignment of obtaining suitable cans, making such modifications as would be necessary, obtaining the product and filling and sealing the cans. This report is largely an account of our activities on this assignment, although sufficient testing was accomplished to provide answers for the original questions.

II. EXPERIMENTAL WORK AND RESULTS

1. Materials

A supply of #10 sanitary cans was purchased, along with a sufficient number of soft drink cans with pull-tab ends. The pull-tab ends were cut off and soldered over 2-inch holes in the lids of the #10 cans. An attempt to fill and seal these cans, however, came to nought, as the sealing machines could not be arranged to accommodate this type of lid.

A supply of aluminum ends was obtained from Alcoa. These ends were of the tab-spiral design that enables the entire end to be pulled out, rather than just a tab. Since these ends were intended to be installed as bottoms (i.e., seamed in at the can factory), they were not provided with gaskets.

American Can Company provided a quantity of cans already equipped with aluminum pull-tab ends, together with a supply of lids with rubber gaskets.

Dewey & Almy Division of W. R. Grace & Company supplied some Neoprene gasketing compound to be applied to the bare Alcoa lids or substituted for the rubber of the other lids.

Crown Cork and Seal Company donated a supply of #2½ can bodies.

Gaskets of Neoprene were added to those lids that were without gaskets, and a portion of those lids having rubber gaskets were stripped and regasketed with Neoprene.

2. First Series

All cans were #2½ size. They were filled with approximately 750 ml. each of Amoco Super Premium gasoline and sealed on the canning equipment of Dekalb Cannery. The fill height was such as to leave a void space of approximately 3/8 to 1/2 inch.

The assembly schedule included the following:

A. Six cans with conventional, lacquered bodies and Neoprene gasketed aluminum pull-out lids.

B. Six cans with aluminum pull-tab bottoms and Neoprene gasketed conventional steel lids.

C. Six cans with aluminum pull-tab bottoms and rubber gasketed conventional steel lids.

Samples of each type were placed in the oven and brought up to 150 degrees F. Each was kept at that temperature for 2 hours, removed and placed in the dry ice chamber, unless there was reason for discarding it.

Sample A came out of the heat with the aluminum lid badly bulged and the lid seam puckered at one point. It was removed from further testing, as unsafe.

Sample B developed a bulged aluminum end, but the end was intact, so the sample was put through one dry ice cycle. There was no adverse effect on the can from the low temperature. Two days later this can was opened, and the gasoline effervesced in the manner of ginger ale in a freshly opened can or bottle. Apparently, the low temperature caused separation of the lighter fraction, which then bubbled off when the pressure was released.

Sample C burst at the lid seam during the heating and was discarded.

Further testing of these samples under heat was discontinued, since the all-aluminum end appeared not to have sufficient strength to stand the vapor pressure developed. Storage is being continued at room temperature in order that gas chromatograph curves may be run after reasonable periods.

Cans sealed with rubber gaskets and opened after a one-week storage period contained bits of rubber that had swelled in the gasoline and come loose from the gasket. These cans were emptied to avoid the hazards of leakage. Neoprene gaskets showed no deterioration.

3. Second Series

On a previous visit to Crown Cork and Seal Company, we had been shown some beverage cans with all-steel construction, except that an aluminum pull-tab was inserted in the end. This is the type of can used for various soft drinks, beer, etc. The tab inset is sealed on the inside with a plastic material to prevent leakage. Although it meant going to a smaller can size than had been anticipated, it was felt that some experimentation

with these would be informative. Consequently, we obtained from Crown a supply of these cans with lids.

Arrangements were made to use a sealing machine in the laboratories of The Coca Cola Company, and samples were prepared. Each of these cans contained 350 ml. of Amoco Super Premium gasoline. The cans remained in the oven at 150 degrees F for two hours, then were removed for examination and transfer to the dry ice cabinet.

Examination revealed that these cans had failed at the lid gasket and that, contrary to our impression, these gaskets were rubber, rather than Neoprene. The remainder of these samples were discarded.

4. Third Series

A new set was prepared by first stripping the rubber gaskets from the lids then replacing them with Neoprene gasket material.

These samples were kept at 150 degrees F for 3 hours. There was no leakage at the seams and no bulging of the ends. However, leakage now developed around the aluminum members - the pull-tab inserts. Examination revealed that the plastic material used as a sealant to prevent leakage at this point had softened in the gasoline at the high temperature, permitting penetration. Leakage ranged from 0.3 to 2.3 grams over the 3 hour period, which is not very much, but too much to be tolerated.

Further testing with this series was discontinued.

5. Related Tests and Evaluation

A gas chromatograph of the original gasoline was recorded, together with a printout of the integrals under the peaks. When cans have been in storage at room temperature for a sufficient period, this will be repeated on the product to determine whether there has been any significant change in the chemical composition during storage.

Some of the cans were sealed with only air. One-quarter-inch holes were drilled in the ends, and short sections of flanged copper tubing were soldered in the holes. The tubing was then connected to a nitrogen cylinder having a 200-pound gage. The pressure to the can was gradually increased until failure occurred. The cans burst at pressures ranging from 75 to 115 pounds, the failure occurring in each case at the lid seal (the end applied in the laboratory).

Experimentation was discontinued at this point for lack of funds. However, recommendations for further work are included in this report.

III. CONCLUSIONS

The concept of packaging gasoline in pull-tab containers appears to be both feasible and advantageous. However, the results thus far obtained indicate that the following restrictions would apply:

(1) An all-steel construction is required, except that the pull-tab may be of aluminum.

(2) In order to avoid the use of heavy gage steel, packages should be kept small. It is suggested that either a #2½ can (3-7/8" diameter, 4-1/2" height), or the "coffee can" size (3-7/8" diameter, 5-1/4" height), should be the maximum. Capacities of these two sizes, allowing necessary void space, are approximately 25 and 29 ounces, respectively.

(3) Seals around the pull-tab, at the steel-aluminum joint, should be of a material, such as polyester or epoxy, that is insoluble in gasoline, yet has sufficient strength to sustain the pressure.

(4) Lid gasket material should not be of rubber, but of Neoprene or other elastomer that is insoluble in gasoline.

(5) Cans should be packaged, either individually or in multiple units, in cartons that would protect them against mechanical damage. Since the smaller sizes are recommended above, it is suggested that a six-pack of some type be considered.

(6) Maximum storage temperature should not exceed about 165 degrees F.

It is our opinion that a fuel of the type used in these experiments, packaged in accordance to these recommendations, will present no explosion hazard during normal transit, storage, and merchandising.

These conclusions are drawn from experiments that are, obviously, incomplete. It is recommended that further testing be done of the final package before marketing, in order to provide assurance of adequate performance of the product.

IV. RECOMMENDATIONS

It is unfortunate that we were unable, for lack of funds, to proceed with necessary modification of the all-steel, aluminum tab can and testing of these cans under storage conditions. Since present results indicate that such a modified can would be satisfactory, it is recommended that the following program be considered:

(1) A supply of "beverage" cans will be used. These will be treated so as to strip from the steel-aluminum joint the plastic materials now applied in the plant. These joints will then be coated with polyester, epoxy, or other suitable plastic to seal the joint against gasoline leakage.

(2) The lids will be stripped of their rubber gasket material, and Neoprene gasket material will be applied in its place.

(3) The cans will be loaded with Amoco Super Premium gasoline, or other satisfactory product, and sealed.

(4) Samples of the sealed product will then be subjected to the tests originally designated in order to determine leakage, chemical changes, and potential explosion hazards.

Respectfully submitted,

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Approved:

[redacted]

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