GEORGIA INSTITUTE OF TECHNOLOGY
ENGINEERING EXPERIMENT STATION

PROJECT INITIATION

Date: August 26, 1975

Project Title: Poultry Industry Research

Project No.: A-1771

Project Director: Mr. James F. Lowry

Sponsor: Georgia Department of Agriculture, Atlanta, GA

Agreement Period: From August 15, 1975 Until August 14, 1976

Type Agreement: Standard Industrial Agreement

Amount: $138,000

Reports Required: Monthly Progress Letters; Annual (Final) Technical Report

Sponsor Contact Person:

Mr. Hubert F. Jordan, Jr.
Fiscal Resources Officer
Georgia Dept. of Agriculture
Agriculture Building
Capitol Square
Atlanta, Georgia 30334

Assigned to: Productivity/Technology Applications Group

COPIES TO:
Project Director
Director, EES
Assistant Director
Division Chief
EES Accounting
Patent Coordinator

EES Supply Services
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Project File
Other Sue Cobbin; Bonnee Wettlaufer

RA-3 (8-75)

GEORGIA INSTITUTE OF TECHNOLOGY
OFFICE OF CONTRACT ADMINISTRATION

SPONSORED PROJECT TERMINATION

Date: November 2, 1976

Project Title: Poultry Industry Research

Project No: A-1771

Project Director: J. F. Lowry

Sponsor: Georgia Department of Agriculture, Atlanta, Ga.

Effective Termination Date: August 14, 1976

Clearance of Accounting Charges: August 31, 1976

Grant/Contract Closeout Actions Remaining:

- x Final Invoice and Closing Documents
- _ Final Fiscal Report
- _ Final Report of Inventions
- _ Govt. Property Inventory & Related Certificate
- _ Classified Material Certificate
- x Other Final Technical Report

Assigned to: Productivity and Technology Applications (School/Laboratory)

COPIES TO:

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Division Chief (EES)
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Director, Physical Plant
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Project Code (GTRI)
Other_____

CA–4 (3/76)

A 1771

ENGINEERING EXPERIMENT STATION
GEORGIA INSTITUTE OF TECHNOLOGY • ATLANTA, GEORGIA 30332

September 5, 1975

Georgia Department of Agriculture
Agriculture Building
Capitol Square
Atlanta, Georgia 30334

Attention: Mr. Hubert F. Jordan, Jr.

Subject: Monthly Progress Summary Letter for EES/GIT Project A-1771 for period 15 August to 1 September 1975 #1

Dear Mr. Jordan:

This summarizes activities on project A-1771 with tasks designated as follows:

001 Methane Generation for Waste Utilization
003 Packaging Technology
005 Poultry Industry Energy Conservation
006 Egg Marketing

Task 001:

Purchase of holding, mixing and digestor tanks was initiated for the pilot facility to be built in Cumming, Georgia. Drawings and surveys were initiated. This activity will continue through the next period.

Task 003:

Work continued in this area under project 1737 and reported in that activity letter.

Task 005:

Initial planning and familiarization begun during the period.

Task 006:

Outside marketing consultant contacted and preliminary plans for a survey discussed.

Sincerely,

J. F. Lowry
Project Manager

Approved By: _____
R. L. Yobs
Laboratory Director

mh

A-1771

ENGINEERING EXPERIMENT STATION
GEORGIA INSTITUTE OF TECHNOLOGY • ATLANTA, GEORGIA 30332

October 3, 1975

Georgia Department of Agriculture
Agriculture Building
Capitol Square
Atlanta, Georgia 30334

Attention: Mr. Hubert F. Jordan, Jr.

Subject: Monthly Progress Summary Letter for EES/GIT Project A-1771 for Period 1 September to 30 September 1975 #2

Dear Mr. Jordan:

This summarizes activities on Project A-1771 with tasks designated as follows:

Task 001

Design and engineering drawing preparation of the piping and electrical control systems for the 10,000 gallon digestor was continued. Purchase orders were issued as designs are frozen. Instrumentation house has been delivered on site. This design phase will continue through the next period.

Task 003

Work continued in this area under Project A-1737 and is reported in that activity letter.

Task 005

Familiarization visits were made to a poultry processing plant, hatchery, feedmill and broiler growout houses for the purpose of defining processes to analyze for energy reduction modifications. Several areas were chosen and alternative modifications are being evaluated. During the next period the most promising modifications will be designed for actual installation and demonstration.

Task 006

During this period an outside marketing agency was contracted to study the effect of attitudes about cholesterol on the consumption of eggs. The contractor, Mr. Tom Farrell, found a gallup poll study on this very question. As a result a meeting of the Egg Advisory Committee was called to discuss the best approach. It was agreed that Mr. Farrell would study the Gallup study as well as information as to marketing eggs by the pound and report back to the committee in December. This effort is continuing and will continue through the next period.

Sincerely,

James F. Lowry
Project Director

mh

Approved By: _____
R. L. Yobs
Laboratory Director

A-1771

ENGINEERING EXPERIMENT STATION
GEORGIA INSTITUTE OF TECHNOLOGY • ATLANTA, GEORGIA 30332

November 5, 1975

Georgia Department of Agriculture
Agriculture Building
Capitol Square
Atlanta, Georgia 30334

Attention: Mr. Hubert F. Jordan, Jr.

Subject: Monthly Progress Summary Letter for EES/GIT Project A-1771 for Period 1 October 1975 through 31 October 1975 #3

Dear Mr. Jordan:

This summarizes activities on Project A-1771 with tasks designated as follows:

001 Methane generation for waste utilization
003 Evaluation of packaging equipment needs in poultry processing plants
005 Energy conservation demonstration in the poultry industry
006 Egg marketing study

Task 001

Design and component procurement for the 10,000 gallon digestor in Cumming, Georgia continued. All major, lead-time items have been ordered. Several components have been delivered and site preparation has begun. Engineering drawings for the facility are essentially complete. Next period will evidence continued assembly and installation.

Five 5-gallon laboratory digestor systems have been assembled, leak checked and pronounced completed for evaluation of the digestion process under several controlled conditions. This laboratory effort has taken more effort than originally planned because of plumbing and instrumentation difficulties associated with operating in an oxygen free atmosphere. These have been overcome and the digestors will be charged in the next period with little detrimental effect on the operating of the large digestor.

Task 003

A report on the preliminary results of several data gathering site visits was prepared with the results to be discussed during the upcoming advisory committee meeting to ascertain the direction of effort in the packaging area. This meeting will be held during the next period.

Task 005

Directed efforts this period to the analysis of system to utilize "reject" heat from refrigeration systems in poultry processing plants. This could be a considerable source of heat energy and result in an appreciable saving of fuel for heating water. Also analyzed the use of overflow scald tank water and closed circuit heating systems for their energy saving potential. Measurements in the selected facilities are being made in preparation for modifying certain processes.

Task 006

The full Gallup market survey report has been received and a review and report preparation are now being conducted. Investigation into trial sales of eggs by the pound is being conducted with little current success. This effort will continue through the next period.

Respectfully submitted,

James F. Lowry
Project Director

mh

A-1771

ENGINEERING EXPERIMENT STATION
GEORGIA INSTITUTE OF TECHNOLOGY • ATLANTA, GEORGIA 30332

December 2, 1975

Georgia Department of Agriculture
Agriculture Building
Capitol Square
Atlanta, Georgia 30334

Attention: Mr. Hubert F. Jordan, Jr.

Subject: Monthly Progress Summary Letter for EES/GIT Project A-1771 for Period 1 November 1975 through 30 November 1975 #4

Dear Mr. Jordan:

This summarizes activities on Project A-1771 with tasks designated as follows:

001 Methane generation for waste utilization
003 Evaluation of packaging equipment needs in poultry processing plants
005 Energy conservation demonstration in the poultry industry
006 Egg marketing study

Task 001

Installation of the 10,000 gallon digester in Cumming, Georgia is continuing. Engineering drawings are complete, most components have been delivered, grading and cement work is complete and component assembly will begin early next period.

The 5-gallon laboratory digesters were charged early in the period and the incubation period started. Preliminary data analysis indicates that hydrogen head gas increases the rate of incubation and that the gas rate of production is higher for thermophilic (135°F) operation than mesophilic (95°F). Late in the period, leaks through the pressure switches were discovered and the manufacturer has agreed to furnish leak free switches. The next period will be used to install the new switches.

Task 003

A meeting was held with Mr. Jack Ellerbee, Chairman of the Tech Advisory Committee and Abit Massey and it was decided to evaluate several ideas that members of the Advisory Committee have and settle on one or more of these for conceptual study. Definition of these ideas will be accomplished on December 16, 1975 when a full advisory committee meeting is scheduled.

Task 005

Continued evaluation of energy conservation measures in various poultry facilities. Observed start-up and shut-down operations at several processing plants to determine their hot water requirements and operational procedures. Prepared demonstration plan for several conservation measures at a particular plant. Made presentation to facility management and expecting their firm commitment to such demonstrations early next period.

Task 006

The Gallup market survey report has been completed and will be presented to the advisory committee meeting on December 16, 1975. A survey on the sale of eggs by the pound has been conducted by the University of Kansas and data from this is anticipated next period.

Respectfully submitted,

James F. Lowry
Project Director

JFL:sm

R. L. Yobs, Lab Director

ENGINEERING EXPERIMENT STATION
GEORGIA INSTITUTE OF TECHNOLOGY • ATLANTA, GEORGIA 30332

January 2, 1976

Georgia Department of Agriculture
Agriculture Building
Capitol Square
Atlanta, Georgia 30334

Attention: Mr. Hubert F. Jordan, Jr.

Subject: Monthly Progress Summary Letter for EES/GIT Project A-1771 for Period 1 December 1975 through 31 December 1975 #5

Dear Mr. Jordan:

This summarizes activities on Project A-1771 with tasks designated as follows:

001 Methane generation for waste utilization
003 Evaluation of packaging equipment needs in poultry processing plants
005 Energy conservation demonstration in the poultry industry
006 Egg marketing study

Task 001

Installation of the 10,000 gallon digester in Cumming, Georgia is continuing. Mechanical installation is estimated to be 80 percent complete and electrical hookup has begun. Several critical items have not been delivered as scheduled; however, these problems are being solved as they arise. Hookup and checkout will continue next month.

The 5-gallon laboratory digester system has been prepared for valve installation but the valves have not arrived as scheduled. These are anticipated the next period.

Task 003

A poultry industry advisory committee meeting was held on December 16, 1975 to discuss various aspects of industry mechanization and to derive areas of interest for further mechanical design efforts. The areas considered by the committee to be critical to the industry are as follows:

1) Broiler catching, hauling and unloading systems.
2) Automated packing of whole birds at the end of the process line.
3) Bird counting systems in the processing plants.
4) Noise abatement studies and education.
5) Reduction of BOD, COD and grease concentration in waste water.
6) Turkey loading mechanism.
7) Utilization of poultry manure.
8) Selling of eggs by the pound instead of by the dozen.

After much discussion it was agreed that conceptual studies will be conducted of items #1 and #2 during the period from January through June 1976. From these studies will be determined the feasibility of finding a solution to the problem and the approximate cost in dollars and manhours for such an effort. These conceptual studies will be internally funded by the Engineering Experiment Station.

Notification was received that this contract will be reduced by 3.5 percent or $6580 and it has been decided to remove these funds from this task as the conceptual studies will be internally funded by EES.

Task 005

Received commitment from processing plant to insulate steam lines although they declined to insulate chillers or recover the compressor heat. Held meetings with several other firms and have general commitments for energy saving modifications. Analysis will be made of each operation and submitted for approval. This analysis work will continue through the next period.

Task 006

A report of the Gallup survey was presented to the advisory committee meeting and accepted as complete. This concludes the work on the effect of cholesterol information on the purchases of eggs. However, the committee previously asked us to investigate information available as to marketing eggs by the pound and this will continue. As a result of the committee meeting a plan for actually testing the selling of eggs by the pound will be formulated during the next period.

Respectfully submitted,

James F. Lowry
Project Director

R. L. Yobs, Laboratory Director

ENGINEERING EXPERIMENT STATION
GEORGIA INSTITUTE OF TECHNOLOGY • ATLANTA, GEORGIA 30332

February 3, 1976

Georgia Department of Agriculture
Agriculture Building
Capitol Square
Atlanta, Georgia 30334

Attention: Mr. Hubert F. Jordan, Jr.

Subject: Monthly Progress Summary Letter for EES/GIT Project A-1771
for period 1 January 1976 through 31 January 1976 #6

Dear Mr. Jordan:

This summarizes activities on Project A-1771 with tasks designated as follows:

001 Methane generation for waste utilization
003 Evaluation of packaging equipment needs in poultry processing plants
005 Energy conservation demonstration in the poultry industry
006 Egg marketing study

Task 001

The methane digester has been completely installed in Cumming, Georgia. The electrical systems have been connected and checked out. Filling with water, depth probe calibration, leak checking and complete system checks will continue through the next period.

Valves have been installed in the 5-gallon laboratory digesters and system checkout is underway. These will be recharged next period.

Task 003

This task is unfunded as the result of the 3.5% budget cut.

Task 005

Instrumentation obtained for measuring effect of chill tank and scald tank heat recovery systems instituted in a participating broiler processing plant. Have several commitments from processors to implement modifications and we will measure the effect. Working with several broiler farmers to improve lighting and ventilation systems.

Task 006

A market test plan for evaluating the effect on sales of selling eggs-by-the-pound has been formulated and test markets are now being sought.

Respectfully Submitted,

James F. Lowry

R. L. Yobs
Laboratory Director

ENGINEERING EXPERIMENT STATION
GEORGIA INSTITUTE OF TECHNOLOGY • ATLANTA, GEORGIA 30332

March 3, 1976

Georgia Department of Agriculture
Agriculture Building
Capitol Square
Atlanta, Georgia 30334

Attention: Mr. Hubert F. Jordan, Jr.

Subject: Monthly Progress Summary Letter for EES/GIT Project A-1771 for Period 1 February 1976 through 29 February 1976 #7

Dear Mr. Jordan:

This summarizes activities on Project A-1771 with tasks designated as follows:

001 Methane generation for waste utilization
003 Evaluation of packaging equipment needs in poultry processing plants
005 Energy conservation demonstration in the poultry industry
006 Egg marketing study

Task 001

Leak checking and calibration of the various instrumentation systems have been completed on the 10,000 gallon digestor in Cumming, Georgia. Initial charging with poultry manure and the incubation time are anticipated for the next period.

The 5 gallon laboratory digestors have been completely checked out and charging with manure is anticipated next period.

Task 003

This task is unfunded as the result of the 3.5% budget cut.

Task 005

Fluorescent lighting has been installed in a poultry broiler house and energy use data will be gathered over the next few months to compare with control house.

Continuing work on heat recovery systems for several processors and acquiring data on steam line insulation system. Acquired commitment on insulating chillers and acquiring comparison data.

Task 006

A test market for evaluating the sale of eggs by-the-pound has been set up with Ogletree's Markets in North Atlanta. Display information has been printed and placed in the store and a data acquisition system has been developed. Data on sales volume will be acquired through the next period.

Respectfully submitted,

James F. Lowry

R. L. Yobs
Laboratory Director

ljb

A-1771

ENGINEERING EXPERIMENT STATION
GEORGIA INSTITUTE OF TECHNOLOGY • ATLANTA, GEORGIA 30332

April 9, 1976

Georgia Department of Agriculture
Agriculture Building
Capitol Square
Atlanta, Georgia 30334

Attention: Mr. Hubert F. Jordan, Jr.

Subject: Monthly Progress Summary Letter for EES/GIT Project A-1771 for Period 1 March 1976 through 31 March 1976 #8

Dear Mr. Jordan:

This summarizes activities on Project A-1771 with tasks designated as follows:

001 Methane generation for waste utilization
003 Evaluation of packaging equipment needs in poultry processing plants
005 Energy conservation demonstration in the poultry industry
006 Egg marketing study

Task 001

Initial loading of the 10,000 gallon digestor in Cumming, Georgia, was started. Several materials handling problems have developed and been alleviated throughout the loading operation. It was found initially that the manure in the holding tank tended to bridge over when the screw conveyor operated. This would not allow for proper filling. Subsequent operations have not experienced this phenomena and it may have occurred because of resistance to flow by the sidewalls. This will be continually monitored.

The feed stock mixer is powered by a used 3 horsepower 3 phase motor reduced to single phase. When making the phase change it was done incorrectly and resulted in the motor stator overheating. This has been corrected and rewired and is operating correctly at this time.

During the extended loading period settling of limestone pebbles, feather stalks, undigested food, etc., has tended to plug the outlet of the digestor. Considerable time has been spent in removing and uncloging plumbing; however, we are now confident that as soon as the digestor is in a daily removal/add mode of operation this problem will be alleviated.

There was a torrential rain during the end of the period that washed dirt from the sides of the loading ramp to the extent that the ramp is currently undergoing major repair to prevent a reoccurrence.

At the end of the period the digestor was approximately 60 percent loaded and this should be completed next period. The digestor has begun to generate small quantities of gas that is about 25 percent methane.

The 5 gallon laboratory digestors have been recharged with mixtures of 10, 20, 30, 40 and 50 percent manure to water to study the effects of solid loading on gas production. Initial results indicate that a 50 percent mixture is much too viscous and 30 percent appears to have the greatest production rate. The pilot facility will be loaded in this 30 percent ratio.

Task 003

This task is unfunded as a result of the 3.5% budget cut.

Task 005

Energy use data are continuing to be acquired from several installed energy conservation modifications. Broiler house ventilation systems are being investigated to determine any possible energy conservation measures in this area.

Task 006

Data on the evaluation of selling eggs by-the-pound is continuing to be gathered and will continue through the next period. There are no preliminary results to report as of now.

Respectfully submitted.

James F. Lowry

R. L. Yobs
Laboratory Director

ljb

ENGINEERING EXPERIMENT STATION
GEORGIA INSTITUTE OF TECHNOLOGY • ATLANTA, GEORGIA 30332

May 6, 1976

Georgia Department of Agriculture
Agriculture Building
Capitol Square
Atlanta, Georgia 30334

Attention: Mr. Hubert F. Jordan, Jr.

Subject: Monthly Progress Summary Letter for EES/GIT Project A-1771 for Period 1 April 1976 through 30 April 1976 #9

Dear Mr. Jordan:

This summarizes activities on Project A-1771 with tasks designated as follows:

001 Methane generation for waste utilization
003 Evaluation of packaging equipment needs in poultry processing plants
005 Energy conservation demonstration in the poultry industry
006 Egg marketing study

Task 001

Initial loading of the digestor was completed early in the period, and the digestor is currently in its incubation period. At the end of the period generated gas composition had reached approximately 45 percent methane and 55 percent carbon dioxide with a ph of 7.2 (slightly basic). The production rate is still very low but the composition and ph indicates that the biomass is developing as experienced in the laboratory digestors.

A mechanical problem that could adversely effect production is that the solids in the feedstock appears to be settling at a faster rate than previously experienced. With this occurring it could mean that all the soluble feed for the biomass would be highly concentrated and therefore not digested at an optimum rate. This may be alleviated when steady-state removal and feedstock addition is achieved or feedstock circulation may be required. This problem will be monitored as time continues.

Repair of the loading ramp and security fence has been essentially completed.

Task 003

This task is unfunded as a result of the 3.5% budget cut.

Task 005

Energy use data are continuing to be acquired from several installed energy conservation modifications. A broiler processor has installed insulated chill tanks and has shown a dramatic reduction in ice consumption. The payback period appears to be about a year. Evaluation of broiler ventilation and egg processing are beginning.

Task 006

The egg-by-the-pound market study has been completed and data analysis is in progress. Indications are that in the short term that sales were little effected by this marketing tool. A full analysis will give more specific information.

Sincerely,

James F. Lowry
Program Manager

R. L. Yobs, Laboratory Director

ENGINEERING EXPERIMENT STATION
GEORGIA INSTITUTE OF TECHNOLOGY • ATLANTA, GEORGIA 30332

June 8, 1976

Georgia Department of Agriculture
Agriculture Building
Capitol Square
Atlanta, Georgia 30334

Attention: Mr. Hubert F. Jordan, Jr.

Subject: Monthly Progress Summary Letter for EES/GIT Project A-1771
for Period 1 May 1976 through 31 May 1976 #10

Dear Mr. Jordan:

This summarizes activities on Project A-1771 with tasks designated as follows:

001 Methane generation for waste utilization
003 Evaluation of packaging equipment needs in poultry processing plants
005 Energy conservation demonstration in the poultry industry
006 Egg marketing study

Task 001

During this period incubation was completed with the gas production rate reaching 20 ft.^{3}/hr. and composition achieving 78% methane and 22% carbon dioxide. At this level the amount of methane began to decrease indicating that maximum biomass had been achieved. Toward the end of the period daily loading of 400 gallons of feedstock and unloading of 400 gallon of effluent was begun. This will continue through the next period to determine gas and effluent quality and production under these conditions.

Task 003

This task unfunded as a result of the 3.5% budget cut.

Task 005

Visits to Crystal Farms, Cagles and Wayne Poultry were made to study different types of operations. Layer operations appear to offer little in energy conservation as they use little total power except for refrigeration and lighting. Efforts in this area will continue. Further processing appears to hold promise and this area is being evaluated in detail. Cagles agreed to implement a number of modifications. These and existing modifications continue to generate data. Preliminary indications show about a 7.5% reduction in broiler growout energy costs by switching to fluorescent lighting.

Task 006

Data analysis and report preparation continued during the period and are in final preparation.

Respectfully submitted,

James F. Lowry

R. L. Yobs
Laboratory Director

ENGINEERING EXPERIMENT STATION
GEORGIA INSTITUTE OF TECHNOLOGY • ATLANTA, GEORGIA 30332

July 12, 1976

Georgia Department of Agriculture
Agriculture Building
Capitol Square
Atlanta, Georgia 30334

Attention: Mr. Hubert F. Jordan

Subject: Monthly Progress Summary Letter for EES/GIT Project A-1771 for Period 1 June 1976 through 30 June 1976 #11

Dear Mr. Jordan:

This summarizes activities on Project A-1771 with tasks designated as follows:

001 Methane generation for waste utilization
003 Evaluation of packaging equipment needs in poultry processing plants
005 Energy conservation demonstration in the poultry industry
006 Egg marketing study

Task 001

During this period daily loading and unloading of feedstock was continued. Maximum gas production rate of 17 ft 3/hr has been achieved with a composition of 63% methane and 37% carbon dioxide. We have not yet reached a true steady-state condition because of equipment malfunctions. The slurry pump has not proved successful in passing the foreign matter found in the manure and is in the process of being replaced. Also breaker contacts, flow meters etc. in contact with the generated gas are corroding at a much faster rate than anticipated because of the hydrogen sulfide and moisture content. These problems are being remedied as they arise and the achievement of steady-state condition is expected the next period.

Task 003

The task unfunded as a result of the 3.5% budget cut.

Task 005

Visits were made to Mar Jac Corporation to acquire energy data on several modifications and these data are now being analyzed. Fieldale

Corporation was visited and recommendations for energy saving modification are being formulated for their processing facility. Analysis of broiler house ventilation techniques are being made in preparation for collecting ventilation data. It is anticipated this will generate an optimum cost system for the insulation and ventilation of the boiler house.

Planning was begun for an energy conservation presentation to be made on August 2, 1976 in conjunction with the monthly poultry processors' meeting. This will be held in Atlanta at a site yet to be determined from 12:30 to 4:30 PM and will feature industry speakers discoursing on various aspects of energy conservation in the poultry industry.

Task 006

Report preparation continued during the period and is in final review.

Respectfully submitted,

James F. Lowry
Program Manager

R. L. Yobs
Laboratory Director

ENGINEERING EXPERIMENT STATION
GEORGIA INSTITUTE OF TECHNOLOGY • ATLANTA, GEORGIA 30332

August 10, 1976

Georgia Department of Agriculture
Agriculture Building
Capitol Square
Atlanta, Georgia 30334

Attention: Mr. Hubert F. Jordan

Subject: Monthly Progress Summary Letter for EES/GIT Project A-1771 for period 1 July 1976 through 31 July 1976 #12

Dear Mr. Jordan:

This summarizes activities on Project A-1771 with tasks designated as follows:

001 Methane generation for waste utilization
003 Evaluation of packaging equipment needs in poultry processing plants
005 Energy conservation demonstration in the poultry industry
006 Egg marketing study

Task 001

Equipment malfunctions continued through the period. The transfer pump was replaced with a more expensive manure pump which appears to have solved the clogging problem. Recirculation has continued for three days with no problems. The gas meter and vacuum pump have been repaired and reinstalled. Modifications are in progress to improve the manure loading into the hold tank as the undesirable conditions created have become unbearable to the community.

Task 003

The task unfunded as a result of the 3.5% budget cut.

Task 005

This project was concluded with a seminar held in conjunction with the poultry processors association monthly meeting. Attendees included management personnel from Mar-Jac, Inc., Tip Top Poultry, Wilson & Company, Cagles, Wayne Poultry, Marrell Poultry, Central Soya and Gold Kist. The program presented results of the demonstration program with suggestion for energy conservation measures in each segment of the industry.

Task 006

Final report completed during this period.

This is the final monthly report for A-1771 and marks the conclusion of the egg marketing study. Methane waste utilization and energy conservation work will continue under Research Project A-1879.

Respectfully submitted,

James F. Lowry
Program Manager

R. L. Yobs
Laboratory Director

A-1771

FINAL REPORT

PROJECT A-1771

POULTRY WASTE UTILIZATION
ENERGY CONSERVATION IN THE POULTRY INDUSTRY
STUDY OF CHOLESTEROL INFORMATION IMPACT ON EGG SALES
MARKET STUDY OF SELLING EGGS BY-THE-POUND

by

R. S. Combes, J. F. Lowry
Dr. D. J. O'Neil, A. D. Poulin

Engineering Experiment Station
Georgia Institute of Technology
Atlanta, Georgia 30332

August 1976

FINAL REPORT

PROJECT A-1771

POULTRY WASTE UTILIZATION
ENERGY CONSERVATION IN THE POULTRY INDUSTRY
STUDY OF CHOLESTEROL INFORMATION IMPACT ON EGG SALES
MARKET STUDY OF SELLING EGGS BY-THE-POUND

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R. S. Combes, J. F. Lowry
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Engineering Experiment Station
Georgia Institute of Technology
Atlanta, Georgia 30332

August 1976

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ACKNOWLEDGEMENTS

The authors gratefully acknowledge the assistance and continued support of the Georgia Poultry Industry without whose direct efforts this work would not have been accomplished. We wish to thank broiler growers and broiler processors in particular for allowing modifications to be made to their facilities for demonstration of energy conservation techniques.

SUMMARY

Research into the technical improvement of the Georgia Poultry Industry is a continuing program at the Engineering Experiment Station (EES) at Georgia Tech. This report covers efforts expended under Research Project A-1771 from August 15, 1975 through August 14, 1976. As several of the projects are long term programs this report will cover the work since the final report on Research Project A-1737. Work is continuing under Research Project A-1879. Each of these projects is discussed in this report.

Work during Research Project A-1771 was directed to three primary tasks:

1) Laboratory and pilot scale studies of the utilization of poultry manure to generate synthetic natural gas (methane) and an effluent of increased value.

2) Energy conservation demonstrations in the poultry industry.

3) Study of the impact of cholesterol information on consumer egg purchases and study of marketing eggs-by-the pound.

The 10,000 gallon digestor located on a layer farm in Cumming, Georgia was charged initially with 50 percent manure, 50 percent water by volume feedstock. This proved to be too viscous and an intermediate dilution of 30% manure, 70% water followed. This mix was allowed to incubate for a period. This period required about 60 days and resulted in a gas production rate of 22 cubic feet of gas per hour composed of 77 percent methane and 23 percent carbon dioxide. During this process several material handling problems occured which reduced the solids content of the digestor and accounted for the low production rate. These problems are being corrected to allow continuous operation.

Several energy conservation modifications were made in broiler houses and broiler processing plants and each proved to reduce energy consumption and have an attractive payback. These included installing fluorescent lighting in

broiler houses, insulating steam lines, insulating chill tanks and reclaiming energy from various overflows in a processing plant. Analyses were made of operations in all segments of the industry and recommendations made for energy saving modifications.

The study of the impact of cholesterol in consumer egg purchases resulted in a thorough analysis and evaluation of a nationwide survey conducted by the Gallup Organization for the National Commission on Egg Nutrition. This study indicated that 55 percent of the American public know of the claim that eggs are a possible cause of heart disease. However, the study also gave insight into many avenues to be utilized in a well planned promotion and marketing program that could have a significant impact on per capita egg consumption.

A study into marketing eggs-by-the pound included conducting a six week test market program in three local supermarkets. This test was inconclusive with no indication of preference or resistance. Customer comments indicated a desire to continue seeing pricing by the pound as it compared with unit pricing of other items in the supermarket.

INTRODUCTION

The activities included in Research Project A-1771 were conducted by the Engineering Experiment Station (EES) at Georgia Tech for the Georgia Department of Agriculture under a continuing program for the technical improvement of the Georgia poultry industry. Research Project A-1771 covers the efforts expended from August 15, 1976 through August 14, 1976. These research efforts were conducted under the general direction of the Georgia Poultry Federation and the project direction and results were monitored by the Tech Poultry Advisory Committee. This committee is made up of leaders from various segments of the industry.

Research Project A-1771 contained three primary tasks:

1) Laboratory and pilot scale studies of the utilization of poultry manure to generate synthetic natural gas (methane) and an effluent of increased value,

2) Energy conservation demonstrations in the poultry industry,

3) Study of the impact of cholesterol information on consumer egg purchases and study of marketing eggs-by-the-pound.

The poultry waste utilization research was a continuation of efforts begun during Research Project A-1659 and continued through Research Project A-1737. Future research will be conducted under Research Project A-1879. This poultry waste utilization work has been documented through March 14, 1976 in the final reports for Research Projects A-1659 and A-1737. This report will contain the information generated from March 15, 1976 through August 15, 1976.

The purpose of this program is to study the anaerobic digestion of poultry waste with the goal of optimizing the quality and quantity of both the generated synthetic natural gas and the liquid and solid effluent. As a result of previous laboratory work, it was determined that a pilot facility located on an operating layer farm would be required to acquire meaningful data to be applied to a

full-scale operating system. A 10,000 gallon digestor with associated materials handling equipment was constructed on a layer farm in Cumming, Georgia during the winter of 1975-1976. This facility is described in detail in the final report for Research Project A-1737.

During March and April 1976 the digestor was loaded with feedstock consisting of 30 percent raw layer manure and 70 percent water by volume after initial additions of 50/50 mixes proved to be too viscous. Ten gallons of cattle manure were added as seed material and the digestor was allowed to incubate at 98°F for the next 60 days. In this incubation process the population of anaerobic bacteria multiplied to fill the entire digestor using the manure as a food source. At the end of this period a gas production rate of 22 cubic feet per hour was achieved with the quality reaching 77 percent methane and 23 percent carbon dioxide. This gas production rate was disappointing. However, materials handling problems dictated an extended loading period and required intermittent removal of solids which probably reduced the food source for the bacteria. The high percentage of methane did prove that poultry manure is a good food source for methanogenic bacteria cultures.

Continuous, daily unloading of effluent and replacement with feedstock was begun after the incubation period was complete. An equilibrium steady state has not yet been attained because of several equipment failures requiring changes in material handling equipment. This is essentially providing food for the bacteria population and is required for continuous digestor operation. Modifications are currently being made to the facility to eliminate these problems and continuous operation is expected within a short period of time.

Concurrently with the pilot facility work, laboratory experiments were being conducted to better understand the mechanics inside the digestor. Several

experiments with 5 gallon batch digestors were conducted and it appears the concentration of 40 percent manure, 50 percent water by volume results in the optimum gas production and optimum methane production. A very important result of this work is that the maximum total gas rate coincided with the maximum methane production rate. This means that maximum methane production rate is an indicator of maximum biomass activity.

Other experiments as to settling rates in the digestor indicate that the solids in the diluted mixture settle back to the approximate original volume which indicates the amount of water needed for dispersal is not critical except for the initial mixing step which allows easy materials handling and interaction of individual particles with the bacteria. If this is verified by further laboratory and pilot facility studies it could have considerable bearing on the economics of the concept; a smaller facility could be utilized for a given throughput. Conversely, the digestor may accomodate up to 3 or 4 times the throughput originally planned. This may be achieved by removal and recycling of the hot water of dilution. These studies will continue through the coming year.

During Research Project A-1737 an energy audit of the Georgia poultry industry was conducted because of the increasing cost and unavailability of fuels normally used. This audit resulted in a definition of the fuels used and of the processes in which they were used. It became obvious that there was no less expensive substitute for the normally used natural gas than the fuel oil that is currently being substituted. Therefore this study recommended that immediate action be taken by the industry to modify equipment and operations to reduce energy consumption. As a result of this recommendation a program to study each process, develop energy reduction plans and demonstrate energy

saving modifications in various industry facilities was initiated in Research Project A-1771.

In this study six segments of the industry were reviewed including broiler production, broiler processing, hatcheries, feed mills, rendering operations and egg production and processing. Several facilities in each segment were visited and each process within each facility was analyzed. Energy use data by process was acquired where available. Each facility was considered a case study with recommendations for energy saving modifications being made to the management of the facility. After the studies were completed, several firms agreed to make the recommended modifications and where possible, to determine the demonstrated energy savings for the modifications. These demonstration programs included replacing incandescent lighting in a broiler house with fluorescent lighting (7 percent energy cost reduction), determining the long term utilization of ventilation fans in broiler houses, insulating steam pipes in a broiler processing plant (3 percent reduction in boiler fuel), insulating an immersion bird chiller in a broiler processing plant (saving of 4 tons of ice per 8 hour shift) and utilizing overflow scald tank and chill tank water to heat and cool incoming make up water in a poultry processing plant. These demonstration programs are continuing and results will be monitored during Research Project A-1879.

In addition to the demonstrated programs, calculations including cost effectiveness were made for many potential energy saving modifications to indicate their desirability. These were presented to the industry along with the outcome of the demonstration programs during an energy conservation seminar held in conjunction with the Georgia Poultry Processor's Association. An example of one of the proposed modifications with the greatest potential for

energy conservation is to utilize the reject heat from the ice maker compressors to heat water for scald tanks and cleanup. Calculations based on a selected plant indicate that there is potentially enough reject heat in this form to supply the entire process heat needs of the plant which operates at 7,000 birds per hour sixteen hours each day. The energy conservation program consists of an extensive modification to the physical plant and a proposal has been submitted to the Energy Research and Development Administration to assist in this demonstration.

As an aid to the egg producer's marketing programs it was decided to conduct a study to evaluate the impact of consumer attitudes toward cholesterol on the sales volume and sales pattern of eggs. In lieu of conducting an inexpensive, local survey with a probability of large statistical error it was decided to conduct an in-depth analysis of a similar nationwide survey conducted by the Gallup Organization for the National Commission on Egg Nutrition. The results of the survey were quite clear. 55 percent of the public knew of the claim that eggs are a possible cause of heart disease, 39 percent of all adults felt eating eggs increased the risk of heart disease, while only 15 percent were aware of the counter claims that no such evidence exists. These are obvious opinions that must be negated by the industry if per capita consumption is to be increased.

Another result of the analysis indicates that there are many directions that the egg industry can take with its marketing program but in any case it must be a positive approach. The industry cannot continue to dwell on the negative cholesterol aspect but must move to the more positive aspects of the product such as good taste, protein value, cost relative to alternatives and appearance. It is recommended this be accomplished in a well planned marketing program with

definite goals for each successive subprogram. Such a program will by necessity be long term as the purpose will be to increase the per capita consumption of a known commodity.

During this program a request was made to investigate the possibility of selling eggs by-the-pound instead of by-the-dozen as is currently done. In evaluating this problem it was decided that customer familiarity with the dozen carton and the cost of new equipment required for a packaging change dictated remaining with the one-dozen package. Therefore, it was decided to concentrate on the marketing and promotion aspects and to conduct a preliminary survey on the reaction to pricing by-the-pound. A six week test was conducted in three retail outlets with egg sales records maintained for eggs priced by the pound and dozen and by the dozen alone. The sales records were totally inconclusive as there was no appreciable change in sales over the test period for the two pricing methods. However, the comments from purchasers were predominantly favorable. This pricing technique essentially retains the dozen price but side-by-side shows the per pound price which is the same as unit pricing for other items in the store. This type of pricing should direct the consumer to compare relative per pound prices between eggs, cheese, pork and beef and obtain a truer picture of the inexpensive nature of eggs. Therefore, this study recommended that each egg producer print up pricing displays for the supermarkets to use that indicate the per-pound price for each per-dozen price within each size range. Data as to store sales over a long period can then be evaluated relative to previous sales and the cost for printing will be minimal.

I. POULTRY WASTE UTILIZATION

One of the continuing problems associated with the poultry industry is the disposal of manure generated by the birds during their growing and/or laying period. Sources from the available literature give a wide range of manure production but a reasonable range appears to be between 0.2 and 0.3 pounds per bird each day. With current poultry population figures and the above waste production estimate, approximately 11,500 to 14,000 tons of fresh manure are produced in Georgia each day. Generally, this manure is disposed of by spreading upon pastures, crops, gardens, etc. and allowing for natural decomposition and leaching into the soil. In this form it is used as a soil supplement which is, at best, a low return operation for the grower. This method is beginning to experience social and environmental resistance that is sure to increase in the future. Additionally, manure handling is generally a net cost operation.

During Research Project A-1659, initial laboratory experiments were conducted to study the feasibility of utilizing poultry manure as the feedstock for an anaerobic digestor. This digestor, using bacteriological fermentation, would in turn produce a synthetic natural gas (methane), carbon dioxide, solid effluent and liquid effluent. The laboratory experiments provided sufficient data to justify the need for further experimental work. This additional effort has taken the form of continuing laboratory studies and pilot plant studies. The pilot plant studies are being conducted using a 10,000 gallon digestor and associated materials handling equipment constructed on a layer farm in Cumming, Georgia. Details of this facility are contained in the final report for Research Project A-1737.

The overall purpose of this anaerobic digestion research is to determine an optimum practical mode of operation for an on-site digestor and then to develop the economics of such an operation. From this can be developed the economic feasibility of such a concept. Preliminary studies based on laboratory production rates indicate the process will be economically feasible but many factors must be accurately determined before a final economic determination can be made. As noted in the final report for Research Project A-1737 the pilot digestor construction was completed in the Spring of 1976 and the anaerobic digestion research proceeded with two objectives. One objective was to operate the digestor in a plug-flow mode and to obtain synthetic gas generation, methane composition and materials handling data. The second objective was to continue laboratory studies of various solids loadings, solids settling rates and solids dispersion to determine optimum conditions for anaerobic fermentation.

Pilot Plant Studies

After construction of the pilot facility was completed the digestor was filled with water to leak check the system, to check the operational logic of timers, pumps, etc., and to calibrate the feedstock level probes and instrumentation. After this was completed the initial loading of the digestor was begun. Loading was to be completed in 5 days. This amount of time was required because the mix tank was designed to supply only a one day supply of feedstock with a 3 day fermentation time in the digestor therefore, the complete loading has to be spread over the five days. In actuality the loading took three weeks because of various materials handling problems. Attempts to load viscous mixtures of 50% manure and 50% water

caused acute handling problems. Loading of 30/70 manure/water mixtures was decided upon because of its better rheological (flow) properties. The main pump used to load the digestor continually stopped because of feather stalks and foreign matter such as wood blocks contained in the manure. Also the mix tank motor burned out from the heavier than expected viscous load in the tank.

During the loading period, an undertermined amount of the solid feedstock was lost from the digestor while cleaning and unstopping the pump. Therefore, the desired loading mixture of solids, 30 percent manure/70 percent water, was not maintained. As a result, a substantially lower than expected gas rate was generated during the incubation period. Also, it was not possible with the unexpected pump problems to operate the system on a continuous circulating or continuous loading basis. After the initial incubation period was completed, modifications to the system were made to allow for continuous operation. Tests of the system with the incorporated modifications are just beginning.

Throughout the incubation period the gas production was monitored and analyzed by gas chromatography. These gas data indicated the incubation period lasted 60 days. At the end of this period the digestor was fully populated by methanogenic bacteria that multiplied from the 10 gallons of cattle manure used as a seed material. The gas rate production reached 22 cubic feet per hour which was much lower than anticipated but it is believed the solids removal mentioned above caused this. This conclusion will be tested during the next incubation experiment. Although the rate was low, the gas quality was at a very high level of 77 percent methane. This indicated that it is possible to culture effective methanogenic bacteria from

poultry manure. The data also indicated that if the empty digestor air is purged directly with carbon dioxide from crushed dry ice prior to loading, toxic failure of the bacteria in the feedstock can be avoided.

The digestor was also designed to be operated at a pressure of one psi below atmosphere and it was operated in this manner after the 48th day of incubation. After this mode of operation was instituted the percentage of methane began to rise steadily. However, insufficient data bars any firm conclusion as to the beneficial effects of operating hypobarically. The experiment did demonstrate the technical feasibility of constructing a practical, leak proof digestor.

Another result of this first experiment demonstrated that pH control through the use of additives is not required. The pH was maintained at just above 7 which indicates a slightly basic solution throughout the incubation and subsequent period. It can be concluded that low pH values are symptomatic and not the cause of toxic failure.

The viscosity of the sludge in the cone of the digestor was determined. A sample was taken after the gas production had reached its maximum. It was found that digestion changes the feedstock from an extremely non-Newtonian fluid to a Newtonian one having a viscosity slightly greater than 100 centipoise. This result greatly reduces the digestor engineering and construction requirements since it was originally feared that the sludge would become a cement-like solid without continual agitation.

Early in the loading period it became evident that settling of the solids in the feedstock, other than foreign matter, was occurring. Although the rate and extent of settling could not be accurately determined because of mechanical problems it was obvious that the efficiency of digestion would

be reduced substantially more than that originally envisioned from the pure top-loading plug-flow mode. Plug-flow requires that each subsequent addition of feedstock maintain itself in a discrete zone relative to the previous and subsequent additions until it progresses down the digestor and is removed. During this progression the digestion is taking place and will be completed just before exiting the digestor. Other reactor design studies indicate this to be the most efficient form of digestion. However, settling and diffusion would obviously reduce this efficiency.

This settling, however, may actually work to the economic advantage of the system. Since it appears that the digestion process occurs within the volume of sludge and since laboratory tests indicate the amount of water used in solids dispersion is not critical after initial mixing as long as the particles are dispersed, then this settling may allow the entire volume of the digestor to be used instead of the 30-50 percent now used. Two new modes of operation are being designed into the system. Both would essentially inject feedstock into the digestor and remove the supernate or added water until the digestor is full of solids with a 70-80 percent water content. Laboratory tests show that the dispersed manure in a diluted mix will settle back to its original volume, that is, the same volume as the raw manure originally added. Therefore, the throughput of the digestor would be increased 3 fold for a given digestor size. The facility modifications for the two modes of operation to test this principle are currently being made.

A new type of manure pump has been installed in the system and has, to date, operated satisfactorily. Additional equipment improvements are underway to overcome mechanical and electrical problems experienced and to improve system reliability.

Laboratory Studies

An experiment was conducted to evaluate the effect of solids loading on digestor performance. Concentrations of 10, 20, 30, 40 and 50 percent raw layer manure mixed with water by volume were loaded into 5 gallon batch digestors. The air in each digestor was removed by replacement with nitrogen and the temperature was maintained at 98°F. The pressure in each digestor was maintained at 3 psi above atmospheric pressure. The feedstock was prepared from the same batch of manure by step-wise dilution in a large batch mixer.

The 50 percent concentration proved to be impractical. The loading mixture was so viscous that gas bubbles from the fermentation could not escape, causing the feedstock mass to rise out of the digestor. This result sets an upper limit for the operating concentration of the pilot facility. The 20 and 30 percent concentrations underwent toxic failure for unknown causes.

The 10 and 40 percent concentrations successfully fermented. Both charges attained a gas composition consisting of 77 percent methane. The 10 percent concentration required 42 days to incubate and the 40 percent concentration required 73 days. The total gas quantity produced for the 10 percent concentration is 5.74 cubic feet having a total time average composition of 58.4 percent methane and for the 40 percent concentration is 15.6 cubic feet having a total time average composition of 62.6 percent methane. The maximum gas rates obtained were:

Concentration	Total Gas	Methane
10 percent	1.40 liters/gal/da	1.14 liters/gal/da
40 percent	2.34 liters/gal/da	1.67 liters/gal/da

An important result of these experiments is that the maximum total gas rate coincided with the maximum methane production rate. This means that maximum methane production rate is an indicator of maximum active biomass concentration.

The above production rates are somewhat less than expected and a hypothesis has been advanced to explain the inhibition. The hypothesis holds that when the feedstock is exposed to air, a critical level of sulfate ion concentration is reached. The sulfate ions are produced from the sulfur proteins present through aerobic fermentaion. When this critical level of sulfate concentration is reached the methanogenic bacteria are inhibited. The fatty acids produced by the acid-forming bacteria cannot then be converted by the methanogenic bacteria. The acids, which are waste products, toxify the bacteria which produced the acid and the whole interrelated system shuts down. The addition of powdered calcium carbonate not only neutralizes the acid present but also reduces the sulfate ion concentration through precipitation, resulting in successful fermentation as observed in earlier laboratory experiments. Further laboratory experiments will be performed to test this hypothesis.

When settling became evident in the pilot facility laboratory, experiments of the phenomena were immediately initiated. The very important outcome of these experiments was the finding that chicken manure settles back to the original volume of manure that was initially dispersed. Therefore, it appears that the amount of water used to disperse the manure is not critical except for initial mixing of particles and bacteria, as well as transfer. All that might be required for fermentation to occur is that the manure be dispersed. This could greatly improve digestor design since the

heated diluent water may be re-cycled rapidly for the subsequent mixing operation. Experiments are designed to prove that reaction occurs mainly on the solid phase.

Studies are continuing into modes of operation that utilize the settling characteristics of the dispersed manures. A special laboratory reactor to study these is nearly complete. Additional studies are underway to study digestor operations at the 140°F level.

II. ENERGY CONSERVATION DEMONSTRATIONS IN THE POULTRY INDUSTRY

The increase in the cost of energy in recent years has affected all facets of American life. Industry has been most affected by rising energy cost because of low priority designation for the industrial users of natural gas. This low priority designation has forced many industries to the use of more expensive energy sources usually with no increase in productivity. Thus, although energy requirements of industrial processes have remained the same, the cost of the required energy has risen sharply. In order to recover some of the increased energy costs, industry has been seeking measures to reduce the amount of energy required for production costs through energy conservation.

A great potential for energy conservation presently exists in the Georgia poultry industry. Industry leaders have recognized this potential and have actively sought technical assistance in order to identify opportunities for energy conservation within all sectors of the industry. The Georgia Department of Agriculture has provided funding for the Engineering Experiment Station at Georgia Tech to survey energy usage in the Georgia poultry industry and to identify and demonstrate energy conservation measures which can be adopted by the industry.

The initial phase of the EES energy conservation program consisted of an industry survey of energy usage in all sectors of the Georgia poultry industry to identify energy use patterns. The results of this energy audit are presented in Table I.

TABLE I

1974 Georgia Poultry Industry Energy Use*

Sector	Energy Use BTU's	% of Total	BTU/Unit	Cost/Unit
Broiler Processor	1,372 Billion	40%	3,320/Bird	$0.011/Bird
Broiler Producer	1,096 Billion	32%	2,660/Bird	$0.012/Bird
Feed Mill	720 Billion	21%	330,000/Ton	$1.15/Ton
Hatchery	128 Billion	4%	310/Chick	$0.002/Chick
Egg Processor	104 Billion	3%	226/Doz.	$0.002/Doz.
TOTAL	3,420 Billion			

*Not including transportation costs

This report presents the results of the second phase of the EES program and discusses measures for reducing industry energy usage. Several demonstration projects were started in which recommended modifications were actually adopted and the effect of the modifications was monitored to determine the reduction in energy consumption. Material and labor which were required for the demonstration projects were provided by the facility at which the modifications were made. Where available, this report presents the results of the demonstration projects. In other cases, operating data will be compiled on the demonstration project modifications and made available to the industry over the next year.

BROILER PRODUCTION

An evaluation of the energy consumed by the poultry industry in Georgia indicated that approximately 32 percent of the total industry energy consumption is attributable to the broiler growout operations. This figure indicates

that energy conservation in growout operations could cause significant reductions in the total energy requirements of the industry.

Two types of house structures are addressed below--the side curtain house with fan ventilation and the totally enclosed, windowless house. In general the primary energy consuming systems are common to both structures and include lights, ventilation systems, heating systems, and feeding and watering systems. Because of the low level of power consumption and the relative simplicity of the feeding and watering systems, these systems will not be addressed with regard to energy conservation.

Side Curtain House

The advantages of a side curtain house from the standpoint of energy consumption are the utilization of natural lighting and ventilation which this type of construction offers. However, the higher rate of heat loss from a side curtain house relative to a windowless house during the winter represents a disadvantage. Each of the major energy consuming systems in the side curtain house is discussed below.

--Lighting--

Artificial lighting of a broiler house requires electrical energy. In a side curtain house, natural lighting will provide sufficient lighting levels (0.5 to 1.0 foot candles) even when the curtains are closed, providing the curtain material is translucent. Typically, lighting systems are needed only 12-16 hours a day in the side curtain house. Thus, in an operation which require continuous lighting, energy conservation is possible by improving the efficiency of the existing lighting systems. For this project the existing incandescent lighting system in a selected side curtain house was replaced

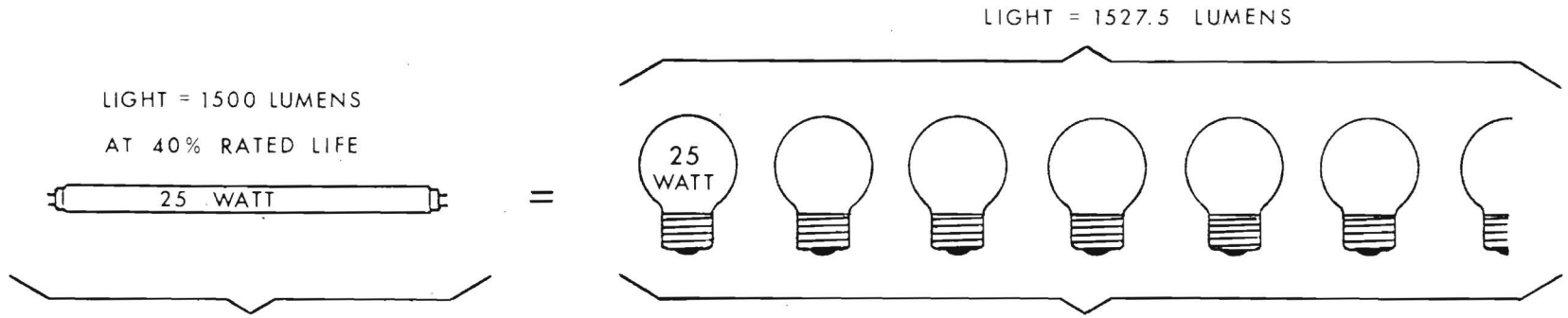
by an equivalent fluorescent lighting system. Inspection of the data presented in Table II indicated that the power required for the fluorescent lighting system was reduced by 375 watts (0.375 Kilowatts), while the illumination level is almost doubled. This is due to the fact that for the same power level, fluorescent lights provide over five times as much illumination as do incandescent lights. See Figure I. In addition, Figure I shows that fluorescent lamps can be expected to last 3 times as long as incandescent lamps, based on switching the lamps every three hours. For a 12 hour switching cycle, the fluorescent lamps can be expected to last even longer.

Table II
Demonstration Project - Broiler House Lighting

Type Structure:	Side-Curtain with fans
Dimensions:	Approximately 300 ft. x 34 ft. (10,200 square feet)
Old Lighting System:	25 fixtures with 25 watt incandescent bulbs, with timer for 12 hours on - 12 hours off. Power consumption - 625 watts (.0625 kilowatts)
New Lighting System:	10 fixtures with 20 watt fluorescent bulbs, tied into existing timer. Power Consumption - approximately 250 watts
Old Lighting Level:	0.67 foot candles
New Lighting Level:	1.08 foot candles

For the demonstration project outlined in Table II, savings in electric energy costs were evaluated by comparing the difference in electric bills for the house with the fluorescent lighting system and an identical house with incandescent lighting at the same location. Reductions in total house

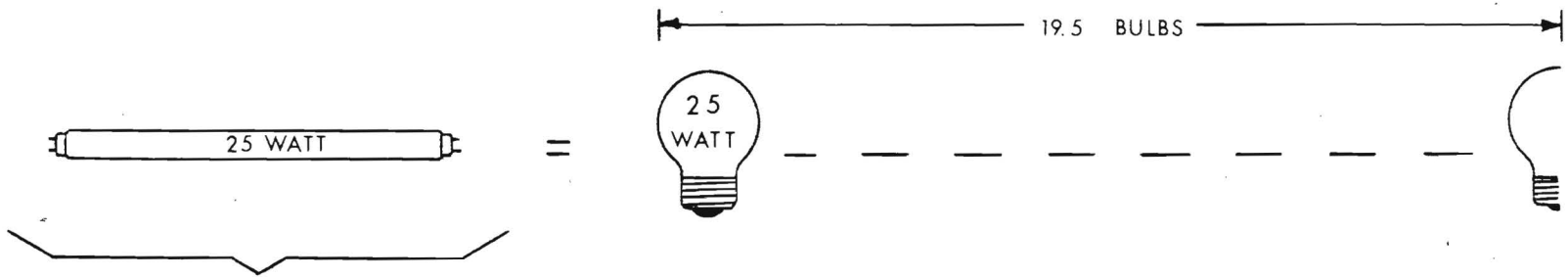
POWER REQUIREMENTS



LAMP	POWER	25 WATTS
+ BALLAST	POWER	5 WATTS
TOTAL	POWER	30 WATTS

ELECTRIC POWER = 167.5 WATTS

BULB REPLACEMENT



7500 HOURS
[AT 3 HOURS BETWEEN STARTS]

FIG 1

LAMP COMPARISON

electric costs averaged $5-5.50 per month. In evaluating the installed cost of the fluorescent lights, the return on investment was less than one year, considering savings in both electric power cost and bulb replacement cost. The only inherent disadvantage of fluorescent fixtures is the fact that the illumination from a fluorescent lamp will degrade to some extent over the life of the lamp. However, this can be compensated for by taking the degradation into account when selecting the fixtures.

An energy audit performed by the Georgia Tech Engineering Experiment Station (Reference 1) prior to the demonstration project fixed energy cost for broiler production at 1.2¢/ bird. The results of the demonstration project indicate that replacement of incandescent lighting with comparable fluorescent lighting can reduce this energy cost by approximately 6.7 percent.

--Ventilation--

The basis for selection of ventilation fans is usually first cost of equipment. However, a series of tests made at Cornell University (Reference 2) evaluated the operating efficiencies and attendant electric energy costs. The test report indicates that the most efficient fan operates on up to 38 percent less power than the least efficient fan. Thus, although the first cost of the more efficient fan is higher, the lower operating cost of the fan may make it a better investment than a less efficient but cheaper fan. In order to evaluate the investment value of a particular fan, Georgia Tech is conducting a long term monitoring program on ventilating fans in a selected broiler house to establish a utilization factor for the ventilation system, i.e. the length of time that the fans are running.

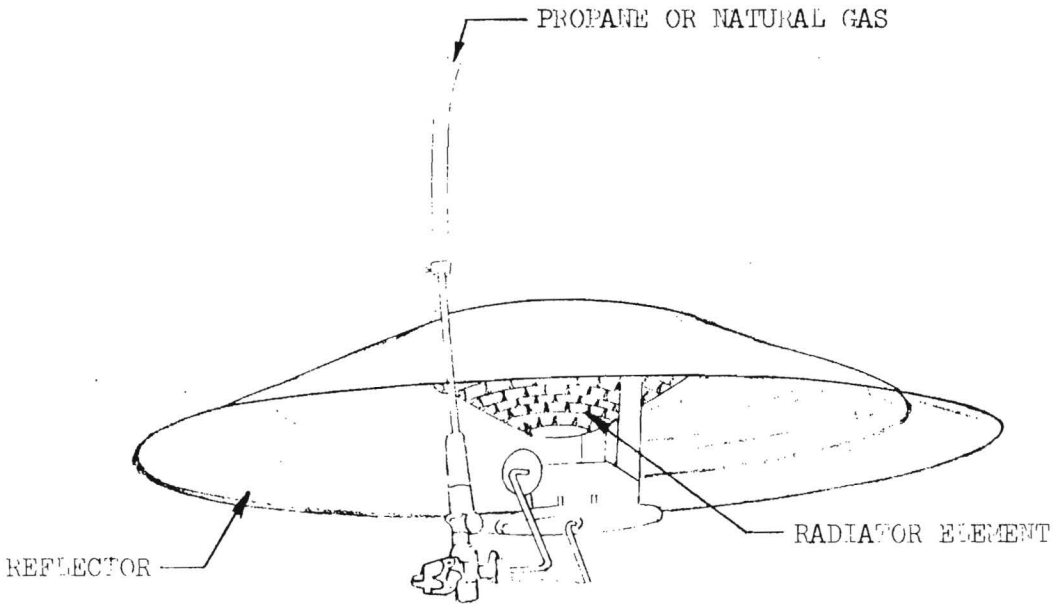
Controls of ventilation systems offer another means of conserving energy. Sequential controllers which turn on fans in sequence over a range of temperatures will reduce fan running time, and thereby reduce electric power requirements. A more sophisticated time-proportioning control of the ventilation system and the heating system has been developed by Reece and Harwood (Reference 3). Such a time-proportioning controller would offer greater accuracy in controlling the environment in the growout house.

--Heating--

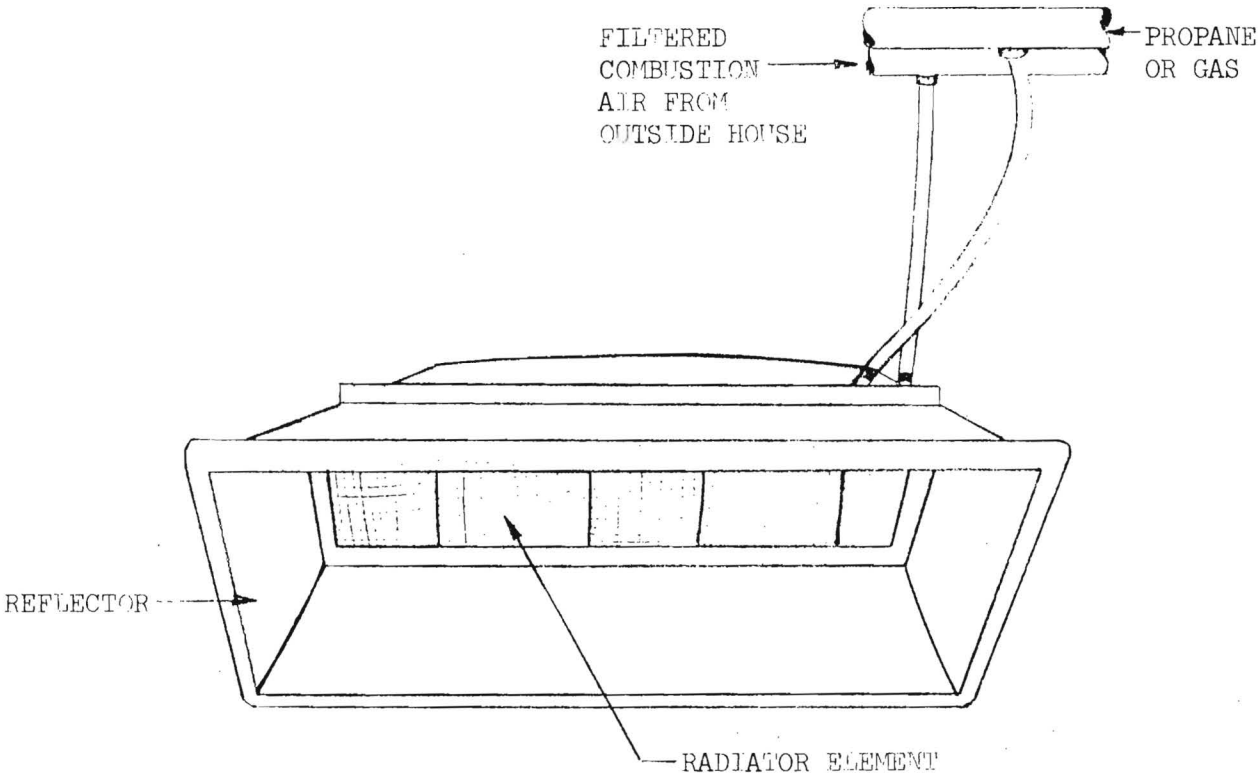
The energy required for heating a side curtain house is by far the largest energy requirement in the production operation. The most common method of heating is by brooders fired with natural gas or propane. These brooders act as infrared radiators and heat the chickens by radiant heat. One means of improving the efficiency of the brooders is to increase the efficiency with which the ceramic radiator element is heated by burning fuel. Use of a flat radiator as shown in Figure II has proven to be a very efficient type of radiator surface (Reference 4).

Another possibility for providing the heat needed in a house is with a solar heating system. Georgia Tech personnel are currently working on a project involving a solar heating system for a broiler house in Cumming, Georgia. If such a system is successful, energy cost for heating could be drastically reduced.

Insulation of walls and ceilings in broiler houses can significantly reduce the fuel needed for house heating. For example, 2 inches of fiberglass insulation added to a 1-inch plywood wall will reduce the heat loss through the wall by over 77 percent (see Figure III). This heat which is lost



TYPICAL BROODER

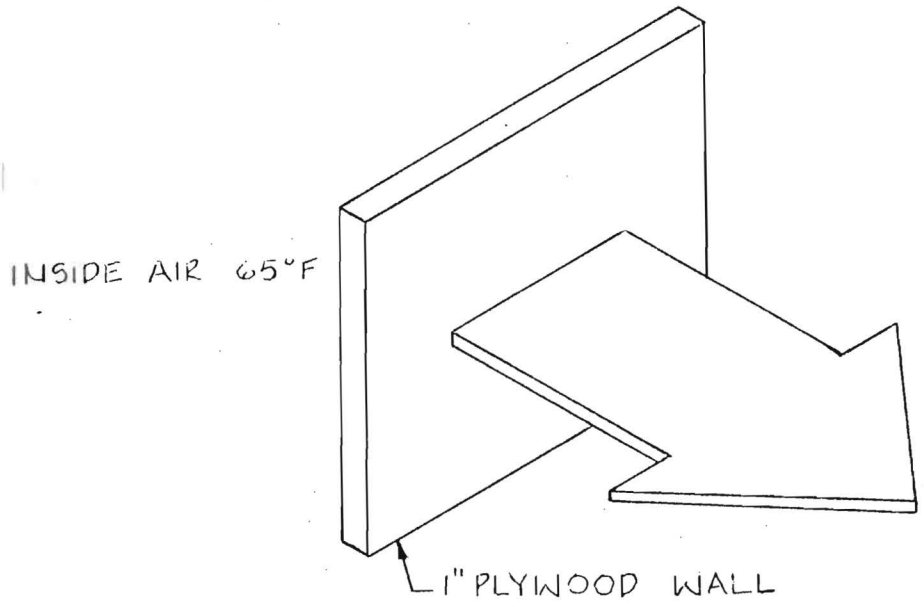


RADIANT HEATER WITH CONTROLLED
COMBUSTION AIR SUPPLY

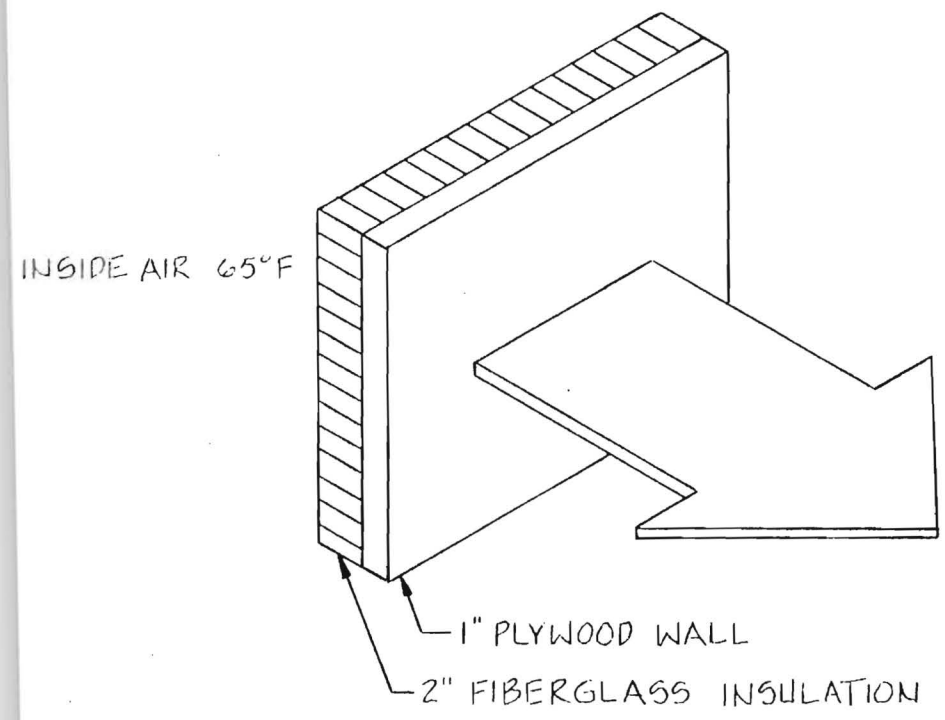
BROODER TYPES

FIG. II

UNINSULATED WALL



INSULATED WALL



VALUE OF WALL INSULATION

FIG. III

through the walls and roof of a side curtain house must be supplied by the heat generated from the chickens and by burning fuel in the brooders.

Another means of conserving fuel in a side curtain house which has received a good deal of attention lately is the use of limited area brooding. This method of brooding involves placement of chicks in only 1/3 to 1/2 of the total area of the growout house by confining the chicks with temporary partitions. In this manner, the fuel used for brooding can be reduced substantially (Reference 5). Since the fuel usage during the growout period is greatest during the brooding stage, fuel savings are significant, and the cost to obtain these savings is negligible.

Windowless House

The primary advantage to a windowless or curtainless house is the fact that the environment can be controlled more accurately. However, from an energy usage standpoint the windowless house has several disadvantages when compared to the side curtain house in that it cannot take advantage of surrounding natural environmental conditions.

--Lighting--

A windowless house cannot take advantage of natural light during the daylight hours. For this reason if continuous lighting is desired, electric energy must be used for the lighting system during the day which is not the case with side curtain houses. In order to minimize the activity of the birds, very low lighting levels are usually employed in windowless houses. One scheme which has been used successfully is to cycle lighting for on-off periods. Reece and Deaton (Reference 6) indicate that turning lights on for 15 minutes then off for 105 minutes provides sufficient lighting for best feed conversion.

This lighting cycle at low intensity can reduce production time and increase feed conversion. However, in evaluating the advantages of this type of lighting, the additional electric cost should be considered.

--Ventilation--

As in the case with lighting, a windowless house cannot take advantage of natural conditions. This represents a disadvantage in that electricity for ventilation fans must be always available. Whereas a power failure in a side curtain house can be counteracted by dropping the curtains, a windowless house must have an alternate source of power, such as a diesel generator, maintained for a standby power--a substantial investment for the producer.

--Heating--

Heating a windowless house can be less expensive than heating a side curtain house, primarily because the entire side walls in the windowless house can be permanently insulated, while the side curtains are difficult to insulate. In addition, windowless houses can be sealed better to reduce unwanted leakage of warm air from the structure during cold weather. The sidewall insulation discussed previously should be made a permanent part of the structure in these houses to reduce heat losses and all cracks should be sealed to prevent infiltration of cold air.

Summary

Energy consumption of lighting, heating and ventilating systems can be reduced significantly in existing broiler growout houses with the amount of energy savings dependent on the type of house. In considering energy requirements for new construction, the cost of energy for operating a growout house should be one of the producer's primary concerns in selecting new equipment. A good equipment investment is not necessarily the equipment with the lowest first cost.

BROILER PROCESSING PLANTS

Poultry processing plants use energy in the form of electricity, natural gas and fuel oil. Electric power is used primarily for electric motors and lighting systems. Equipment burning natural gas includes boilers, singers, space heaters and kitchen equipment. Boilers are fired on fuel oil if natural gas is not available. The major energy consuming systems are the refrigeration units for ice making, storage, and chilling, and the steam heating system for scald tank water, cleanup water, and cookers.

In processing plants, the primary refrigerant used in large refrigeration units for ice making, refrigerated chillers, cold storage, blast freezers, etc., is ammonia. These ammonia refrigeration units typically employ evaporative condensers and water cooled ammonia compressors. Condensing temperatures range from 96°F to 85°F.

Steam generated in plant boilers is used to maintain scalding temperature, to cook chicken or offal, to heat spaces, and to heat water for clean up. This steam is generally produced in 200-500 ton boilers and piped directly to the utilizing process. In the process the efficiency of use is determined by the method of introduction and the return of condensate. In most processes in broiler processing plants, inefficient steam sparging with no condensate return is used.

--Insulation--

Insulation in high and low temperature applications is standard practice in industry and the current and projected high cost of fuel and electricity makes insulation an investment which will pay for itself many times over.

Insulation of high temperature components of systems found in broiler processing plants should include boilers and steam supply piping insulation as a minimum. Bare pipe carrying 100 psig steam can lose heat to the surrounding air at the rate of 1000 BTU/hr for every square foot of pipe surface area. This is equivalent to one cubic foot of natural gas lost per hour. If the pipe is insulated with 1 1/2-inches of fiberglass, this heat loss can be reduced to 63 BTU/hr for every square foot of piping for a reduction in heat loss of 94 percent.

In order to demonstrate the effectiveness of insulation on steam distribution piping, a demonstration project was initiated in which a broiler processing plant installed insulation on all steam piping which was previously uninsulated. See Table III. The energy savings resulting from the steam line insulation was evaluated by monitoring the boiler fuel consumption when the boiler was on a standby with no steam requirements. In this evaluation, it was assumed that the standby fuel consumption represented the fuel required to overcome boiler and steam piping heat losses. The fuel consumption was monitored before and after the insulation was installed and fuel saved was taken as the difference between the two rates of fuel consumption. The fuel savings resulting from steam line insulation was approximately 3 percent of the total boiler fuel requirements.

TABLE III

Demonstration Project - Steam Line Insulation

System: 100 psig steam distribution piping for broiler processing plant consisting of

180 feet of 1 1/2-inch pipe
110 feet of 2-inch pipe
70 feet of 3-inch pipe
150 feet of 4-inch pipe
10 feet of 6-inch pipe
5 feet of 8-inch pipe

Insulation installed: 1 1/2" fiberglass insulation w/vinyl jacket - total area of insulation - 367 ft^2

Cost of insulation: $3,400 (including installation cost)

Estimated Annual Energy Savings: $2,241/year

Payback Period: 18 months

Insulation of cold surfaces can reduce the heat gained through these surfaces as effectively as the reduction of heat loss from hot surfaces. Insulation of whole-bird chillers would represent a significant cost savings, because of the fact that the reduction of heat gain to the chillers from the surrounding air would represent a reduction in ice requirements for chillers using ice. Most jacketed chillers which are marketed today are installed with insulation over the refrigeration coils.

A demonstration project was initiated at a processing plant which involved insulating an immersion bird chiller which uses ice to maintain temperature. The demonstration project is detailed in Table IV. The savings in ice due to the insulation was evaluated by monitoring ice consumption in the insulated

chiller and comparing this value with monitored ice consumption in an identical chiller at the same location which was not insulated. The demonstration project has indicated that the insulation of whole bird chillers and giblet chillers is a very good investment. To date, the insulation is withstanding the high pressure clean up water with no adverse effect.

TABLE IV

Demonstration Project - Immersion Chiller Insulation

System: Zebarth whole bird chiller, 60 feet long by 5 feet diameter, aluminum shell, 6590 gallons water maintained at 33°F

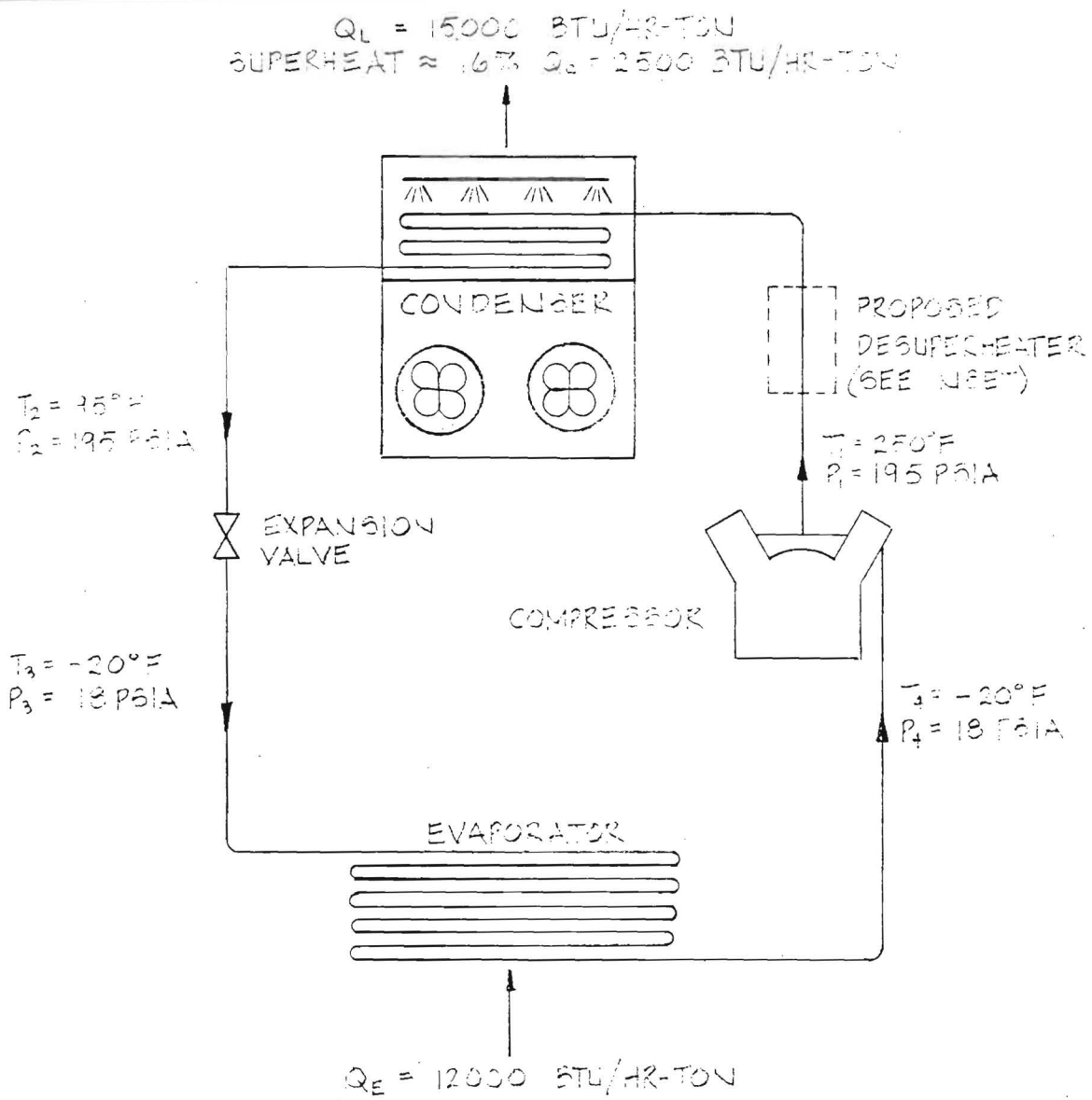
Insulation: 1½ inches Ethafoam, K = 0.24 BTU/hr-in-°F, w/40 mil PVC jacket and silicone sealant

Installation Cost: $3,200 (including labor to install)

Estimated Savings: 4 tons of ice per 8-hour shift, $4000/year (based on ice @ $4/ton)

Pay Back Period: 10 months

Insulation of refrigerated rooms and blast freezers is common practice in the poultry processing industry. However, further savings can be realized by installation of flexible curtains or air curtains in entrances to refrigerate spaces to minimize the escape of cold air when loading on unloading the rooms.



HEAT RECOVERY FROM
AMMONIA REFRIGERATION

INSET

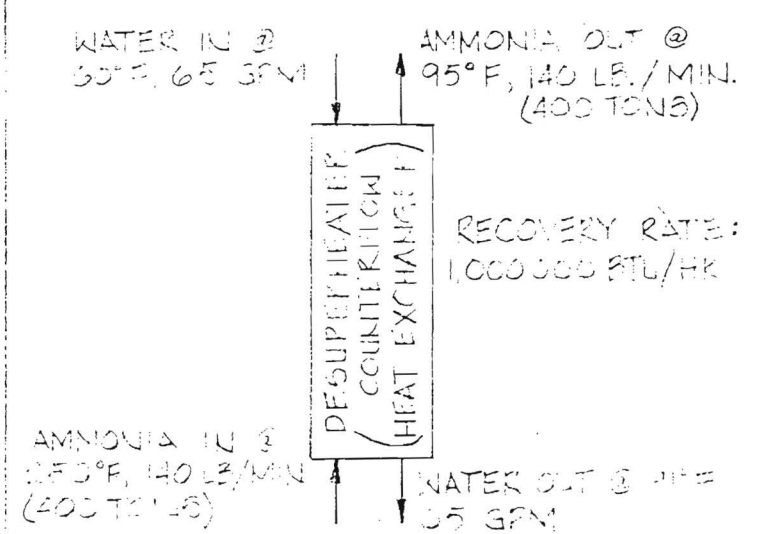


FIG. 17

Energy Recovery

Rising fuel and electric costs have dictated an evaluation of systems for recovering process heat and refrigeration effect which have not proved to be reasonable investments in the past when energy was relatively inexpensive. Broiler processing plants are particularly suitable for energy recovery because of the requirements for large quantities of low grade hot water in the scalding operation.

Areas for consideration of energy recovery include the following:

1) Recovery of condenser heat from refrigeration units: for every ton (12000 BTU/hr) of refrigeration, approximately 1.25 tons (15000 BTU/hr) of heat must be rejected from the refrigerant in the condenser. Operation of large ammonia refrigeration units typically found in processing plants employ evaporative condensers to reject the condenser heat to the atmosphere. Thus, in addition to throwing away 15,000 BTU/hour per ton of refrigeration, electric power must be used to operate the evaporative condenser. Since temperatures of the ammonia at the compressor discharge of a reciprocating compressor are typically 250°-275°F, recovery of a portion of this discharge heat to heat water would represent a reduction in the steam required form the boilers. For example, if a shell and tube heat exchanger were installed in the ammonia line between the compressor discharge and the ammonia condenser of a 400 ton refrigeration unit, approximately 1,000,000 BTU/hr would be available to heat water when the compressor is operating. See Figure IV.

2) Recovery of waste water heat and refrigeration: the USDA requirements of minimum overflows from the scald tanks and whole-bird chillers constitute wasted energy if these flows are simply discharged to the plant drainage system. The largest energy cost to maintain desired temperatures in the scald

tanks and chillers is the cost to heat makeup water for the scald tanks and to chill makeup water for the chillers. Energy recovery systems can be used on both the scald tank and the chillers to recover a substantial portion of the wasted energy from the overflows. These recovery systems consist of a screening device to filter out grease, suspended solids and feathers from the overflow water, a pump, and a heat exchanger which transfers heat from scald tank overflow to scald tank makeup (See Figure V). Used on a whole-bird chiller, the exchanger prechills makeup water to the water chiller using chiller overflow.

In order to demonstrate the effectiveness of energy recovery systems at both the chiller and the scalder, energy recovery systems which were being installed at a new processing plant were instrumented to evaluate the performance and operating cost of these systems. Table V presents the details of the demonstration project. Due to operational problems associated with startup of the processing plant, extensive operating data has not yet been compiled for these energy recovery systems. These data are expected during the coming year.

TABLE V

Demonstration Project - Energy Recovery Systems
for Bird Scalder and Bird Chiller

Systems:	Bird Scalder - Barker immersion scalder, overflowing 126°-128°F water at 30 gallons per minute
	Bird Chiller - Barker refrigerated immersion chiller, overflowing 50°F water from prechiller at 60 gallons per minute.
Screening Systems:	Screen tanks - 304 stainless steel tank to screen large solids from overflow, with three vertical screens removable for cleaning.

TABLE V (continued)

Pumps: At scalder - 2 horsepower, 304 stainless steel centrifugal pump
At chiller - 5 horsepower, 304 stainless steel centrifugal pump

Heat Exchangers: Multiple plate type heat exchanger, 304 stainless steel, installed in straight counterflow manner.

Makeup Water: City water ranging from 40° to 80°F throughout year

Cleaning System: Clean-in-place chemical cleaning daily

Recovery System Cost: At scalder - $5200
At chiller - $7700

Estimated Annual Savings: Will be available when sufficient operating data has been compiled.

3) Recovery of refrigeration compressor heat: water cooled refrigeration compressors utilize recirculating cooling water which reaches a temperature of 110° or higher. Installing a water to water heat exchanger to recover heat from the cooling water to heat water can recover approximately 350 BTU/hr for every horsepower of refrigeration compression.

--Lighting System--

Although the lighting system in a processing plant represents a small percentage (2 percent) of the total electric power consumption, savings can be realized by reducing lighting levels during operation and cleanup periods and switching lights off whenever possible. These savings are available with essentially no capital investment so that the savings in decreased energy costs would be available immediately.

HEAT RECOVERY SYSTEM FOR SCALDER

(A) POULTRY SCALDER
(B) PUMP
(C) HEAT EXCHANGER
(E) SCREEN TANK

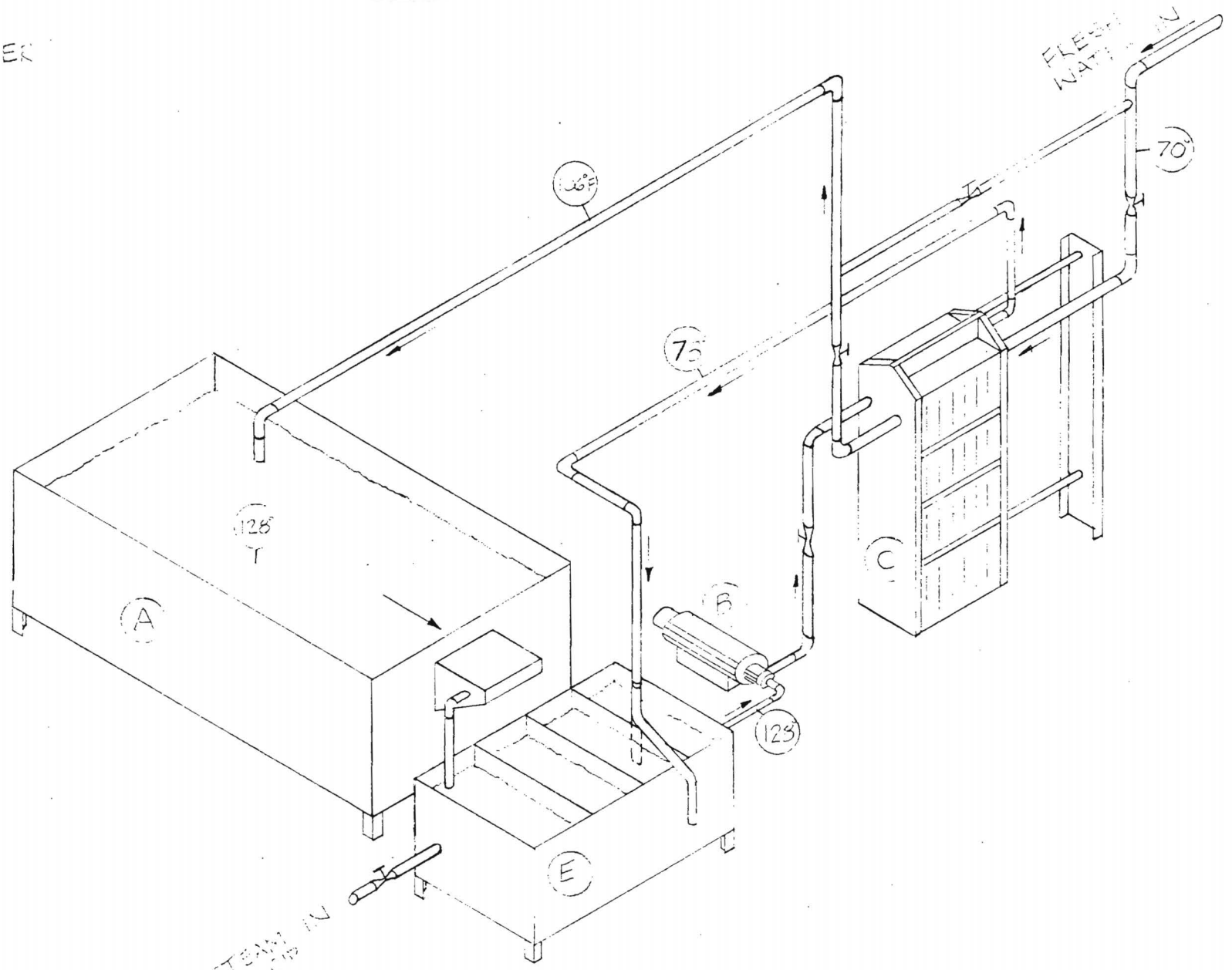


FIG. V

Operation of equipment is often dependent on automatic control. Installation of automatic controls can often represent a cost savings due to increased efficiency in equipment operation.

1) Temperature regulation of high pressure pumps: high pressure water pumps employed in plant cleanup typically use steam for heating water. If the steam is regulated to control the temperature of the hot water rather than allowing a constant flow of steam, steam requirements are decreased.

2) Metering ice flow into chillers: in plants where ice is used to maintain chiller temperature, the USDA will allow credit for ice added to maintain a 2 quart/bird overflow. Common practice in processing plants is to meter the makeup chill water but not the ice added. If, for example, 40 tons/day of ice is used to maintain chiller temperature, weighing the ice on a metered basis could reduce chill water requirements by 9500 gallons/day. This would represent over 23 percent of the chill water requirements for a processing rate of 80,000 birds/day. Thus, the energy cost required to chill 9500 gallons/day would be saved in addition to water cost and treatment cost of the water conserved. An alternate means of receiving credit for ice added would be to control the chiller overflow rate through a flow control valve regulated by line speed and add makeup chill water through a flow control valve controlled by level in the chiller.

3) Condensate return system: installation of steam traps and condensate return on steam heating systems will yield substantial savings in energy required to generate steam. Condensate return systems can be employed with any steam system which does not result in contamination of the process steam, i.e., steam cookers in rendering plants.

--Operations--

A major factor in realizing energy savings is accurate control of equipment operations to attain the maximum possible operating efficiency. The maximum efficiency which is guaranteed by package boiler manufacturers is typically 80 percent. This indicates that at least 20 percent of the heating value of the fuel firing the boiler is lost up the stack. A number of factors in boiler operation can further decrease the efficiency including excess combustion air, erratic fuel control and deterioration of boiler internal components. Each operating boiler should be checked daily with respect to combustion efficiency. A combustion check is a relatively simple procedure and the fuel savings realized will more than pay for the man hours expended.

In addition to boiler combustion, efficient system operation requires attention to the steam distribution system. Idle boilers should be isolated by closing valves. Steam heating systems should be isolated by positive shut-off valves in the steam line when steam is not needed. These measures will prevent steam loss through leaking control valves, heating coils, etc. Steam heating systems should be designed to minimize wasted steam. For example, a steam heater or steam mixing valve to heat makeup water to the scalder would make more efficient use of steam than supplying all the steam needed through the steam sparging system in the scalder.

Another area of operational energy reduction is electric peak demand control. Although control of electric peak demand will not result in any energy savings, the net effect will be a reduction in energy costs due to the nature of the electric demand billing. Control peak demand can be implemented through elimination or reduction of electric load during a period when electric demand is high throughout the plant. For example, during processing operations in

summer months when the load on the refrigeration units is a maximum, nonessential electric loads can be reduced or eliminated to limit the peak kilowatt load and thus reduce the peak demand billing. Peak load control requires constant monitoring of electric demand and rapid switching of loads to be reduced. Packaged peak control units are available which will continuously monitor electric loads when the demand approaches a predetermined peak value. However, these units are expensive and cost savings are difficult to evaluate.

Cleanup operations in processing plants have been addressed in the past from the standpoint of water conservation. Because of the fact that much of the water used is heated with steam, conservation of water will result in reduced fuel cost. Since about 4 gallons of water per bird is used for cleanup, wherever possible, cold water should be used for cleanup operations.

Summary

Energy conservation can be a source of savings in operating costs of boiler processing plants to varying degrees, dependent on the plant design. New processing plants are being designed which will incorporate many energy conserving features. However, any existing processing plant can reduce energy costs by 10-20 percent if a commitment is made by top level management and cooperation of all employees is encouraged. This initial report has presented a number of energy conservation measures which are generally applicable to processing plants in Georgia. A comprehensive energy conservation program whould begin with a complete energy utilization survey of a plant to identify specific areas in which conservation is physically and economically feasible.

HATCHERIES

Energy consumption in hatchery operations include electric power for incubators, hatchers, lighting and various pumps and motors. Natural gas or liquid petroleum gas is used for heating water and for space heating. Each of the systems which consume energy are discussed below.

--Incubators--

The largest users of electricity in the incubators and hatchers are the resistance heating elements which are used to maintain the desired temperature. The heat added by heating elements is lost either through the walls of the incubator or hatcher, or with the exhaust air which leaves the units. The heat lost through the walls is reduced by the addition of insulation by the manufacturers. Thus, the heat added to the incubator or hatcher is lost mainly due to the exhaust air from the units. One incubator manufacturer indicated that 150 CFM of air is required to be exhausted continuously from each incubator. This air is at approximately 95°F. If all of the exhaust air from the setters and hatchers was directed into a common duct, heat could be recovered from this air to heat air which is used for space heating in the hatchery building (See Figure VI). In this manner, the heat which is added to the air in the incubators and hatchers could be used for space heating and reduce the cost of space heating.

--Insulation--

Most of the areas in the hatchery have controlled temperature and energy is required to maintain the desired temperature levels through use of space heaters, evaporative coolers, etc. One of the most inexpensive methods for reducing the energy required to maintain the temperatures is the use of

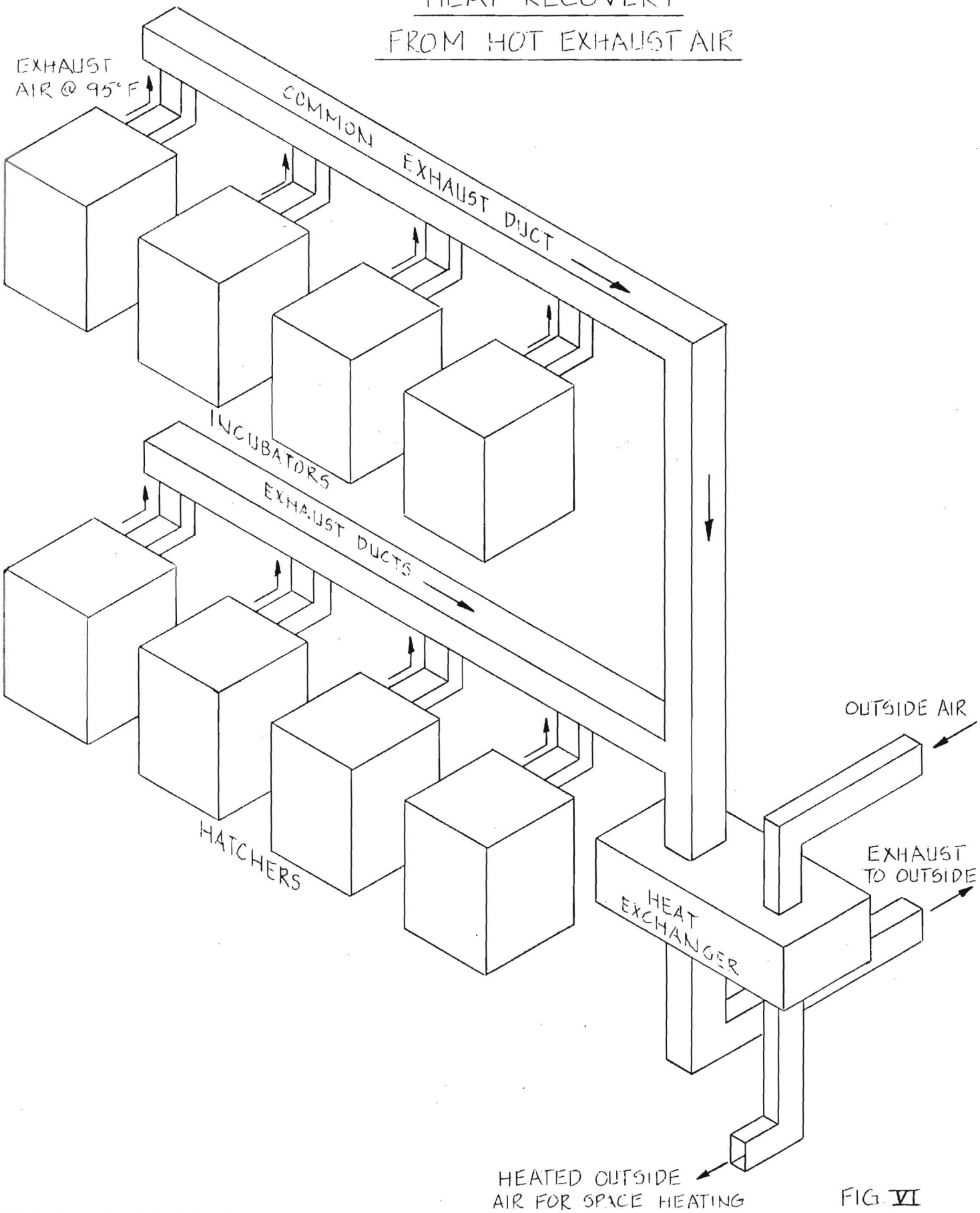

HEAT RECOVERY
FROM HOT EXHAUST AIR
EXHAUST AIR @ 95° F
COMMON EXHAUST DUCT
INCUBATORS
EXHAUST DUCTS
HATCHERS
OUTSIDE AIR
EXHAUST TO OUTSIDE
HEAT EXCHANGER
HEATED OUTSIDE AIR FOR SPACE HEATING

FIG. VI

insulation on ceilings and walls. Construction of hatcheries usually includes ceiling and wall insulation. However, existing insulation levels may be inadequate when considering the rising cost of energy. For example, concrete block walls with vermiculite fill can be upgraded with the addition of a one inch thick polystyrene insulating board to reduce the heat loss through the wall by 56 percent. Additional insulation will further reduce the heat loss.

Energy cost can also be reduced by minimizing the amount of conditioned air leakage. For example, the egg holding room which is usually maintained at 60°-65°F should be provided with some means of reducing escape of conditioned air while the door is open. This can be accomplished with an air curtain or a flexible entry partition such as hanging plastic strips.

FEED MILLS

Energy required for feed mill operation is used in the form of electricity for equipment operations and control systems, and fuel for boiler operation and space heating. Reductions in energy usage are most readily available with those systems which use fuel, i.e., natural gas, propane, or fuel oil. This is due to the fact that components which use electricity, such as electric motors, are inherently very efficient and energy reductions are difficult to achieve except by reducing the size of the component. The discussion below presents recommendations for reducing energy needs in feed mill operation.

--Steam System--

The boiler generating steam for heating fat tanks, pelletizing and, in some cases, space heating should be considered as the device which converts fuel into useful heat energy. The boiler efficiency can vary, depending on the

fuel combustion efficiency and the heat transfer efficiency. Fuel combustion efficiency should be checked regularly by feed mill personnel. This can be done with an inexpensive carbon dioxide analyzer and a stack thermometer with a procedure which takes no more than five minutes. Heat transfer efficiency can be maximized by maintaining a water treatment program for boiler feedwater and periodically inspecting the boiler internal surfaces.

After the steam is generated in the boiler, it must pass through the steam distribution system to the point of application and condensate must return to the boiler. The heat lost from the steam in the piping system costs just as much as the heat used in the operation and wasted heat can be significant, especially with steam piping running outside of buildings. Steam piping, fat storage tanks, and condensate piping should have proper insulation and the insulation should be maintained in good condition. Steam traps should be inspected regularly and repaired when needed. Steam needed to heat fat in storage tanks might be minimized by using suction heaters at the point where the fat is drawn from the tank rather than maintaining a large volume of fat at an elevated temperature.

--Electrical Systems--

The increasing cost of running equipment powered by electricity has necessitated a reevaluation of specific items to try to reduce operating costs. For example, feed conveying systems using large blowers can be replaced by bulk handling systems such as bucket elevators with a large reduction in motor horsepower. This resulted in a ten percent energy reduction for one feed mill.

Heat generated by equipment such as air compressors can be utilized in some cases to reduce heating requirements. For example, if the fat storage tanks were located in an area with air compressors, the heat generated by the operation of the air compressors could reduce the steam required to maintain the fat temperature. It should be noted however, that the inlet air to the air compressor should always be unheated outside air.

RENDERING OPERATIONS

The greatest energy requirement in a rendering plant is the fuel used to generate steam. For this reason, substantial savings in fuel cost can result by employing heat recovery and a comprehensive maintenance program.

--Heat Recovery--

Steam used to cook poultry by-products should be recovered as condensate to the greatest extent possible and returned to the boiler as hot feedwater. Using return condensate at 200°F will require over 13 percent less fuel to fire the boiler than when using feedwater at 65°F. In addition, boiler water treatment costs will be minimized by utilizing all the return condensate possible. Another means of heat recovery would consist of installing a heat exchanger in the hot wastewater discharge from the hot well to preheat make-up water to the boiler.

--Maintenance--

Because of the nature of the processes involving steam consumption in the rendering plant, a regular inspection and maintenance program can greatly reduce the cost of wasted fuel.

1. Boiler efficiency should be maintained at 80 percent or better in order to maximize the conversion rate of fuel to steam. All steam lines, cookers, condensate return lines and the feedwater tank should be well insulated.

2. All insulation must be maintained in good condition once installed since wet or torn insulation is almost useless in reducing heat loss.

3. Steam traps should be inspected regularly to insure that they are not leaking. One available method of checking steam trap performance is to install a special heat sensitive tape on the condensate line at the trap. The tape changes color if steam starts leaking through the trap, indicating the need for maintenance.

4. All steam valves and vents should be inspected for leaks periodically and repaired when necessary.

5. Valves should be installed so that any idle equipment with steam piping can be isolated from the live steam system. This practice will minimize the surface area from which steam heat is lost.

The importance of maintaining an efficient steam system in a rendering operation cannot be over emphasized for the reason that such a program represents the most effective management tool for controlling fuel costs.

EGG PRODUCTION AND PROCESSING

Layer operations are similar in nature to the broiler growout operations when considering energy consumption. Therefore, the recommendations presented in the section entitled Broiler Production should be referred to for layer house energy conservation measures.

Egg processing facilities require electric energy for equipment operation and lighting systems. Suggestions for energy conservation measures in egg processing are presented below.

--Egg Storage--

Energy is required to maintain the desired temperature in egg storage areas through use of air conditioning units or evaporative coolers. The energy required for the storage operation can be minimized by assuring that conditioned air does not leak from the storage room. If the loading dock is directly adjacent to the egg storage area, door seals should be fitted on loading area doorways. Adjustable door seals are available to accomodate different truck sizes. Other access doors opening into the storage area should be equipped with air curtains or some other means of containing the conditioned air such as hanging flexible PVC strips.

Insulation of walls in the egg storage area can reduce energy requirements for air conditioning systems significantly. For example, if a storage room is constructed with vermiculite-filled 12-inch concrete blocks, the heat loss through the walls can be reduced by 70 percent with the addition of two-inch polystyrene insulation board.

--Lighting System--

The electrical energy required for the lighting system in an egg processing facility may represent a significant portion of the total electrical energy requirements. A determination of the optimum type of lighting should address the type of lighting and illumination desired and the efficiency of the lighting fixtures in converting electrical energy to light. Table VI gives some comparative data on the efficiency of various types of lighting

TABLE VI

Efficiency of Types of Lamps

TYPE OF FIXTURE	EFFICIENCY (Average Lumens Per Watt Excluding Ballast)
1. Incandescent	17-22
2. Mercury Vapor	42-63
3. Fluorescent	67-83
4. Multi-Vapor	80-115
5. High-Pressure Sodium Vapor	83-140

fixtures. As the tabulated efficiencies indicate, incandescent lights are the most efficient lighting fixtures with regard to operating cost. Another factor to consider is replacement of lamps or bulbs. An incandescent lamp, although having the lowest first cost, will have an expected life of approximately 1500 hours before burning out, whereas a fluorescent lamp in the same service will have an expected life of 5000 hours. Thus, operating and maintenance costs must be considered when evaluating the investment of a lighting system.

--Hot Water System--

Hot water boilers which heat water for egg washers should be equipped with controls so that hot water is delivered to the washer only when needed. A possibility exists for installing a preheating system utilizing the heat rejected from the air conditioning condenser or heat from an incinerator if an incinerator is used for refuse disposal.

III. STUDY OF THE IMPACT OF CHOLESTEROL INFORMATION ON CONSUMER EGG PURCHASES AND STUDY OF MARKETING EGGS-BY-THE-POUND

The steady downward trend in per capita consumption of eggs in the United States has become a major concern of egg producers in Georgia. This continuing trend can only result in a shrinking market with a resulting loss in revenues to the egg producer. It is the opinion of the producers that much of the current adverse publicity relative to eggs has been generated by large food companies promoting their imitation or substitute egg products. These are promoted as being low in calories, fat and cholesterol, and eggs are promoted as abounding in these. It is simple to tie in the conclusion that large amounts of calories, fats and cholesterol are bad for your health and therefore eggs are bad for your health. This type of advertising is very much in evidence in current mass media advertising. In an effort to better understand this situation in preparation for an increased marketing effort, a study of the impact of consumer attitudes toward cholesterol on the sales volume of eggs was undertaken.

After a thorough evaluation of the problem it was decided that an in-depth study and evaluation of the results of a nationwide poll conducted in early 1975 by the Gallup Organization would be of more benefit than a small localized survey. Considering the allocated funds for this project, by necessity, the sample would have been small with a resulting large statistical error in the final results. In contrast, the Gallup poll conducted for the National Commission on Egg Nutrition was quite thorough and statistically accurate. From these results could be drawn the results expected from the localized survey and much more accurately.

As a result of this decision it was decided to concurrently conduct a market study into marketing eggs by-the-pound instead of by-the-dozen as is currently done. A thorough literature search determined that previous studies indicated an acceptance of this marketing method and some even indicated a sales increase. It was decided to conduct an actual market test in three local supermarkets to determine the effect of pricing by the pound on sales volume and size of eggs purchased. Since a packaging change would be quite expensive for the industry, it was decided to retain the one-dozen package and just indicate a per pound price on the normal pricing strip in the store.

This test was conducted over a six week period and the results were inconclusive. Egg sales by total volume or by size were altogether uneffected by the pricing change. Comments indicated that a significant number of shoppers liked the per pound pricing and compared it to unit pricing. The results of this test lead to the conclusion that further testing would produce no definitive results and that the producers should simply supply supermarkets with pricing strips with per pound prices and evaluate their sales over a long term period.

At the beginning of this study it was decided that assistance in the form of marketing expertise was required by the engineering staff at EES to conduct this study. Therefore, Mr. Thomas Farrell of Farrell and Associates was hired to conduct the evaluation of the Gallup study and to conduct the by-the-pound test market. Following is the final report from Mr. Farrell as to the results of his firm's efforts.

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PROJECT REPORT

Research Project No. A-1771-006
Purpose: To investigate and report upon the impact of consumer attitudes toward cholesterol upon the sales volume and sales pattern of eggs.

HISTORY: The steady downward trend over a period of years of per capita egg consumption has caused a great deal of concern among egg producers. Georgia, being the second largest egg producing state in the nation is particularly effected because of the great impact the egg industry has upon the economy of the State. The original concept was to conduct a market opinion survey to see if the belief widely held by the producers - that cholesterol controversy was hurting their business - was true or not.

Preliminary study and research in preparation for conducting the poll resulted in a thorough review and evaluation of the data contained in a similar and more extensive poll conducted in early 1975 by the Gallup Organization for the National Council on Egg Nutrition (NCEN). Rather than replicating part of the more extensive survey, a copy of the report of the Gallup organization was obtained and studied. From the review of the extensive Gallup survey a summary report answering the questions originally posed was prepared and is attached hereto (Summary of Gallup Poll - Part A: "Cholesterol and Eggs").

Because of the great wealth of information contained in the Gallup Survey and because this information can be of direct assistance in developing a marketing program to increase egg sales, a report on how to use the Gallup Survey was written and is also attached hereto. (Summary of Gallup Survey - Part B: "Using the Gallup Survey")

Because the public attitude questions concerning cholesterol were able to be answered with a minimum expenditure of funds, another major concern of the egg industry was able to be studied under the original contract. The concern was consumer acceptance of and reaction to the sale or marketing of "Eggs By the Pound". A review of current literature on the subject, was undertaken and a brief report of findings and recommendations was prepared. That report is attached hereto.* From this second study came the authorization to conduct a test market of "Eggs By the Pound" in Georgia. The results of that survey are attached hereto (A Test Market of Eggs by the Pound").

* Findings and Recommendations on "Eggs by the Pound"

GENERAL FINDINGS AND RECOMMENDATIONS.

GET OFF DEFENSIVE AND ONTO OFFENSIVE IN COMPETING FOR CONSUMER FOOD DOLLARS

There is no simplistic solution to the problem of steadily decreasing per capita egg consumption. There are, however, a number of steps that can be taken which will move the egg industry off the defensive and put it on the offensive in meeting its competition for the consumer's food dollar. The first step has already been taken; that is the institution of the check-off system. This will provide the financial resources necessary to undertake a nationwide marketing effort. Previously the egg industry marketing efforts have been tremendously fragmented. No resources were available for the kind of sustained and coordinated national marketing campaign which is essential to effect a nationwide change in consumer awareness of attitudes toward eggs. Having made the resources available through the check-off system will not in and of itself bring the desired increases in sales over the long run. Those resources must be used and used wisely. In order to use these resources wisely producers must familiarize themselves with the national market and the various ways in which it can be approached.

INDUSTRY MUST PAY AS MUCH ATTENTION TO SALES AS IT DOES TO PRODUCTION

Egg Industry publications are filled with articles that deal with every nuance of the production side of the business. But articles dealing with effective marketing techniques are very few and far between. This very much reflects the general attitudes of the producers in the past. The steady decline in per-capita sales has made the producers aware of the fact that they cannot take their markets for granted any more. Without sales there are no profits. If the market decline continues producers will be forced into cut throat competition with each other in attempts to maintain their share of a smaller and smaller market. Producers must move positively to expand the market as a whole.

PRODUCERS NEED TO ARM THEMSELVES WITH KNOWLEDGE

The interest in the sales and marketing aspects of the egg industry is a fairly recent phenomenon among producers. The Gallup survey undertaken by NCEN has a tremendous amount of valuable information on the entire food market and the attitudes, beliefs and eating habits of the American consumer. Producers should take the time to read and study and understand this document. Before expensive marketing campaigns are

undertaken it is imperative that the producers who will be paying the tab know the market as well as they know their own farms.

MAKE SALES AND MARKETING A REGULAR PART OF THE AGENDA

One way for producers to become more aware of the market is by making marketing and sales discussions a regular and planned part of all meetings. These discussions should be directed at specific ideas or topics. An individual within each organization should be charged with the responsibility of selecting the topic and leading the discussion thereof. This kind of activity will increase both the awareness and the knowledge of the problems of marketing their product.

ESTABLISH SPECIFIC GOALS FOR EACH MARKETING PROGRAM UNDERTAKEN

Because the check-off system is new and because the approach to the market as a whole is new it is very likely that some mistakes are going to be made and some money wasted. One way to minimize the waste is by formally establishing specific goals for each marketing program undertaken. The criteria for measuring the success of failure of the program should also be established. For example:

Program: Prepare and distribute a booklet titled "The Egg Diet - Good Looks and Good Health".

Cost: $30,000

Write 20 page diet pamphlet	$ 5,000
Print 10,000 copies	5,000
Advertize "Free Copies" in Ladies Home Journal for 6 Months	15,000
Package and mail pamplet to respondents to add	5,000
	$30,000

Goal: To increase awareness among Diet Concious women of the Health and Beauty value of eggs.

Criteria of Success:

(1) 10,000 copies distributed in nine months from date of advertisement.

(2) Two national television appearences by the author in nine months.

(3) Twenty major market local T.V. or radio appearances by author in nine months.

By establishing in advance the desired outcome of each and every expenditure for marketing purposes the chance that a large or continuing waste will occur is minimized. If an advertizing public relations agency is not willing to be specific about what they are going to do and how the success (or failure) of their efforts is going to be measured, then the egg producers should be very wary of making any substantial commitment of funds.

(It must be noted that the industry cannot expect every program to work out as planned. But the industry must be able

to determine if a particular program is working or not so that it can be expanded or abandoned as appropriate in a timely fashion)

SPECIFIC RECOMMENDATIONS

Based upon the studies, tests and discussions executed under this project the following specific recommendations are made.

TAKE POSITIVE APPROACH ON CHOLESTEROL QUESTION

The advertisements placed by NCEN which said in effect "No scientific proof exists which links eggs and heart disease" were very negative. They are self-condemning in much the same way as an individual's statement that "there is no proof that I beat my wife and deprive my children".

Advertisements should play up the many very positive aspects of eggs - eggs taste good; eggs are economical; eggs are nature's most perfect food; etc.

When the Cholesterol question is addressed it should be done in a subtle way. News releases should be made regularly publizing each contrary finding. If necessary, research can be undertaken to follow up on preliminary findings which tend to disprove the egg/cholesterol link to heart disease.

PROCEED TO MARKET EGGS BY THE POUND OVER A MORE EXTENDED PERIOD.

Though the results of the test market of eggs by the pound were not conclusive, there were a number of very positive

indications. Many more favorable comments about the approximate price per pound information being displayed were reported than were negative remarks. The cost of placing strips showing the approximate cost of eggs per pound is negligable.

Rather than fund another test, efforts should be made to implement the production and distribution of pricing strips. A point of sale display which invites comments via a postage paid post card will provide sufficient feedback upon the effectiveness and acceptance of the marketing by the pound program.

PIN-POINT SPECIFIC TARGET MARKETS AND DESIGN CAMPAIGNS TO GO AFTER THEM

The Gallup Survey evidences a number of specific target markets that the egg industry can attack. Each market will require a different approach and each must be evaluated to see if the benefit gained outweighs the cost of attacking the market. Among the markets which the information in the Gallup Survey points to as fruitful markets for development are:

- Dieters
- Economy Shoppers
- The evening meal market
- The meals away from home market
- The young adult market
- The summer meal market

USE ALL THE MARKETING TOOLS AVAILABLE

In setting up a new marketing program the egg industry may be tempted to think in terms of advertising and nothing more.

Effective marketing goes far beyond advertising. The July-August 1976 issue of the Harvard Business review points out that twice as much money is spent on promotion in the United States as is spent on advertising. Outlined below are a few specific marketing ideas.

I. Market research.

Study the results of the Gallup Survey and build upon that very solid foundation. The value of that single resource can not be over estimated. On a periodic basis (every two years or so) undertake a survey to update the information such that the nationwide impact of the marketing programs carried out can be measured.

II. Promotions.

- Point of Sale Displays
- Toy Eggs for Children - the kind where one egg fits inside the other, and the next inside that one, etc.
- "Good Egg" lapel pins.
- "Eggs are good for You' match books
- An egg shaped blimp or hot air balloon
- Egg eating contests
- Egg dieters beauty contest with before and after pictures
- Eggs and Issues forums

III. Advertising

- In food sections of Newspapers
- On radio
- On television
- On billboards

IV. Public Relations

- Press releases (with photographs)
- Appearences of Industry Spokesmen on talk shows
- Donations of eggs for church picnics, school outings, etc.

SUMMATION

The egg industry has a very real problem in the market place. But there is a growing awarness of that problem and a firm commitment to solving that problem. The problem cannot be solved in a day or a year. But the problem can be solved through persistant and reasoned efforts. The studies and tests executed during this project all indicate that the time has come for the egg industry to act.

Other similar industries - the milk and beef industries - currently have industry wide marketing. The "Florida Sunshine Tree" campaign is a very well recognized marketing effort for yet another similar industry. There is no reason why the egg industry cannot be just as aggressive and effective in the promotion and sale of its product.

SUMMARY OF GALLUP SURVEY

Part A

SUMMARY OF GALLUP SURVEY - PART A: "CHOLESTEROL AND EGGS"

SURVEY EXAMINES LINK BETWEEN HEART DISEASE AND EGG CONSUMPTION

The Gallup Organization, issued a report entitled "Eggs in the American Diet" in April 1975. The report was the result of a study

> ". . .designed to investigate public beliefs and attitudes concerning the health value of eggs and how this has affected egg consumption."

The particular question examined in the Gallup survey was the possible linkage between claims that eggs contribute to heart disease and the steady drop in per capita egg consumption.

THE GALLUP SURVEY POSED THREE MAJOR SUBQUESTIONS

In examining the "heart disease - consumption drop" linkage, three major subquestions were posed. These were:

(1) How widely held is belief that there is a health danger in eating eggs?

(2) How widely known are counter claims of egg industry that no scientific evidence exists linking eggs to heart disease?

(3) What are the sources of information upon which attitudes and opinions are based?

The survey determined that the belief that there is a health danger in eating eggs <u>is</u> widely held. The important findings are listed below:

55% KNOW OF CLAIM THAT EGGS ARE POSSIBLE CAUSE OF HEART DISEASE

The Gallup survey found that fifty-five (55%) percent of the American public have heard or read the claim that eggs are a possible cause of heart disease. Of this group almost seventy (70%) percent believe the claim has been proven to some extent; twenty-two (22%) percent of those who know of the claim

believing it has been "definitely proven"; and Forty-seven (47%) percent believing it has been "possibly proven".

65% KNOW OF CLAIM THAT CHOLESTEROL IS POSSIBLE CAUSE OF HEART DISEASE

A significantly greater percentage, sixty-five (65%) percent, of the American public is aware of the claim that cholesterol is a possible cause of heart disease than of the claim eggs are a possible cause (55%). Of those who are aware of the claim against cholesterol, Seventy-four (74%) percent believe it to be proven to some extent. Twenty-nine (29%) percent believing it is "definitely proven" and Forty-five (45%) percent believing it "possibly proven".

39% OF ALL ADULTS FEEL EATING EGGS INCREASES RISK OF HEART DISEASE

The impact upon egg consumption is <u>not</u> restricted to those who feel that the egg-heart disease link has been "definitely proven". Thirty-nine (39%) percent of all adults believe that regularly eating eggs increases the chances that a person will develop a heart disease problem. Only pork products with Forty-two (42%) percent ranked higher than eggs in the "foods to avoid" category. The following list will give a good idea of what the general public felt about which foods increase chances of heart disease:

Food	% who feel regular eating increases risk of heart disease
Beef	6.1
Pork	42.2
Poultry	1.1
Fresh Fruit	.3
Eggs	38.8
Butter	34.3
Margarine	9.6

ONLY 15% ARE AWARE OF COUNTER CLAIMS THAT NO EVIDENCE EXISTS WHICH LINKS EGGS AND HEART DISEASE

Whereas a majority of the public is aware of egg-heart disease claims and a substantial proportion believe claims have been proven to some extent, only Fifteen (15%) percent are aware of counter claims that there is no "scientific evidence" that eating eggs in any quantity increases the risk of heart

disease. Of those who have heard counterclaims, only Thirteen (13%) percent accept them. Thirty-three (33%) percent reject it and Fifty-four (54%) neither accept or reject them.

In addition to the extent to which the public links eggs and heart disease two very important corallary pieces of information were contained in the survey. The first was a breakdown of the sources of information about cholesterol and heart disease. The second was the indication that a significant number of people would increase egg purchases if the heart disease link was disproven.

MASS MEDIA MAKES UP 72% OF SOURCES OF INFORMATION CONCERNING EGG-HEART DISEASE CLAIM

Individuals questioned in the poll were asked to give the sources of information of the claim that eggs are a possible source of heart disease. The mass media accounted for 72% of sources given. Personal conversations accounted for 13%, Doctors for 9%, Hospitals and Clinics for 1%, food advertising for 4% and the American Heart Association for 1%. The breakdown of sources of information concerning claims about the egg-heart disease link and the cholesterol-heart disease link were virtually identical.

A SUBSTANTIAL NUMBER OF PEOPLE WOULD INCREASE EGG PURCHASES IF CLAIMS ABOUT EGG-HEART DISEASE LINK WERE DISPROVEN

Nearly 12% of those surveyed responded that they would make a concious effort to eat more eggs if egg-heart disease claims were disproven. In communities of over one million people, over 18% indicated that they would increase consumption. Among individuals who were overweight, 19% would increase consumption if claims were disproven.

USING THE GALLUP SURVEY

Part B

PART B: USING THE GALLUP SURVEY

It is the purpose of this section of this report to emphasize the value of the information contained in the Gallup survey and give a few specific examples of how the information can be used in putting together marketing campaigns.

In addition to providing information relative to the attitudes and concerns of consumers about the links they perceive between eggs and heart disease, the Gallup Survey also gives very detailed information about the structure and composition of the egg market. Breakdowns of egg consumption habits are given for various age groups, education levels, occupations and geographic regions. The amount of time spent eating breakfast, lunch and dinner on weekdays and weekends is given. The places where each meal is eaten and the fequency with which various foods are consumed at each meal are also provided. In short, the Gallup Survey does not just answer the major questions concerning the adult population's beliefs about eggs and heart disease. It documents in significant detail the eating habits of the American public. Therefore, the information in the Gallup survey can be used as the foundation upon which to build a positive marketing program for eggs. A program which targets specific market segments and then approaches each segment in such a manner that the known,

favorable predispositions held by consumers in each particular segment are reinforced. The goal of any such marketing program is, of course, motivating increased per capita egg consumption. The following sections outline a few specific ways in which the Gallup Survey can be used to identify a market segment and how that segment might be approached.

The examples are intended to demonstrate how the tables provided by the Gallup Report can be used. There are one-hundred-ninety-four (194) tables provided by the Gallup Organization. Each table gives meaningful and useful insights which can be of help in developing an overall marketing strategy.

EXAMPLE NO. 1

Targeting the Weekday Breakfast Market Emphasizing the Time Spent Eating.

Table 25 "Foods Usually Eaten for Breakfast on Weekdays"

This table indicates that the more time a person takes to eat breakfast the more likely he is to consume eggs. The table shows that only 29.2% of those who spend 15 minutes or less eating breakfast usually eat eggs. But for those who take 15 to 20 minutes the percentage rises to 57.9% and among those who take more than 20 minutes for week day breakfasts 64.7% usually eat eggs.

This data suggests a couple of approaches. One would be a marketing campaign directed at extending the time people spend eating breakfast. The sales pitch for eggs themselves could be very very low key,

because statistics indicate that if people did take more time at breakfast they would have a natural inclination to consume more eggs. Indeed, an additional 5 minutes spent on weekday breakfast nearly doubles the propensity to regularly eat eggs for breakfast.

A different approach could be aimed at changing the polulation's perception of the time required to prepare eggs. Table 25 notes that 46.2% of all adults spend 15 minutes or less eating weekday breakfasts. Of this large group only 29.2% usually eat eggs. To increase this percentage a campaign showing how quickly eggs can be prepared could be formulated. Advertisements could show that eggs can be prepared in less time than it takes to percolate a pot of coffee or mix up frozen orange juice. (It should be noted that of those who take 15 minutes or less to eat breakfast 62.9% usually have coffee and 47.7% usually have juice).

EXAMPLE NO. 2

Targeting Increased Consumption
Of Eggs for Dinner.

TABLE 40 "Foods Eaten At Least Once a Week for Dinner"

This table illuminates several areas where egg marketing efforts could be made. The table shows that of the adult population only 21.9% eat eggs once a week at dinner whereas 90.2% eat beef. In addition, the table shows that young people are eating less eggs than their elders. The figures given are:

Age Group	16-24	25-39	40-59	60 & over
% having eggs once a week for dinner	16.5	20.4	24.4	25.7

If they continue in that trend per-capita consumption will continue to drop at an even faster rate than in the past.

Here again several marketing approaches are suggested by the data. One could be aimed at the great price

per pound difference between eggs and beef. From a nutritional standpoint eggs are a good substitute for meat. From a price standpoint eggs are a fantastic substitute for beef. A theme of "put your pocketbook on a diet - eat eggs for dinner" would highlight the great price difference between eggs and beef.

Another approach could point up the ease of preparing eggs for dinner in summer months when people want to ge out of the kitchen as quickly as possible. "Eat a good breakfast for dinner tonight" is attention getting and puts across the idea of eating eggs for dinner.

EXAMPLE NO. 3
Targeting and Increase in Public's
Perception of Eggs are an 'Economical'
and 'Nutritious' Food.

Tables, 79, 82 and 94 detail attitues toward Various foods show the following:

	Eggs	Poultry	Beef	Cheese
Old Favorites	26.5	54.8	63.3	33.1
Particularly Tasty	16.2	38.8	50.1	23.7
NUTRITIOUS	31.8	29.7	54.4	31.2
ECONOMICAL	21.7	58.3	18.1	7.5
Doctors Recommend	20.1	35.5	47.1	21.4
Doctor's Say Avoid	40.7	1.6		

By comparing attitudes toward eggs with attitudes toward other foods some interesting facts emerge. As can be seen from the table above, despite the fact that a pound of eggs costs less than half as much as a pound of beef, the consuming public perceives very little difference between eggs and beef on the basis of economy.

Even more striking is the fact that more people responded that beef was "nutritious (54.4%) than they did for eggs (31.8%).

EXAMPLE NO. 4

Targeting Increased Egg
Consumption Among Dieters

TABLE 100 "Diets to Control Weight" indicates that 19.3% of the food purchasing public is on a diet to control weight.

This group can be very effectively addresed by publicizing the very low calorie count for eggs. A pamphlet describing an "egg diet" could be prepared and distributed. Magazine articles - particluarly for women's magazines could be written.

The foregoing examples are just four specific marketing programs that might be developed based upon information contained in the Gallup survey. That survey contains a wealth of information and that can be very valuable in the positive marketing of eggs.

FINDINGS AND RECOMMENDATION ON "EGGS BY THE POUND"

January 1976

BACKGROUND: Georgia Egg Producers possess a number of feelings about their product and the manner in which consumers react to it which led to the investigation of the sale of "EGGS BY THE POUND". Without attempting to weight or order the reasons in favor of selling "Eggs By the Pound" they were:

(1) Consumers would have a very adverse reaction when the price of a dozen eggs went over a dollar.

(2) A mid western chain of stores had sold eggs by the pound with considerable success.

(3) Selling eggs by the pound could solve the chronic problem of producing a mix of eggs that was different from the the mix that the market demanded.

(4) Consumers would be able to easily compare the value of eggs to other foods (meat, dairy products, etc.) if sold by the pound.

In addition, there were a number of factors about "EGGS BY THE POUND" which the producers felt were major problems. Again without attempting to weight or order the factors, they were:

(1) Selling eggs by the pound would require a great investment in new equipment.

(2) Consumers would react adversely to the sale of eggs in pound bags or any other non "by-the-dozen" means.

(3) Selling eggs by the pound would necessitate mixing sizes.

(4) Selling by pound would require additional handling and thereby raise prices.

Because of the possibility of considerable economic gain and because of the uncertainty about the nature of the potential risks involved, a study of current literature on the subject was authorized. The following report summarizes what has been done over the past few years in this field and gives some of the important considerations in the "EGGS BY THE POUND" approach.

KANSAS SATE AND OTHERS HAVE INVESTIGATED EGGS BY THE POUND

A review of literature available on the topic revealed that quite a bit of work has already been done and a great deal of thought has already been given to the concept of "EGGS BY THE POUND". (A list of references is attached in appendix A). The most current study found was undertaken by the Kansas Agricultural Experiment Station at Kansas State University in mid 1975. The study is titled "PRICING AND SELLING EGGS BY THE POUND AT RETAIL" and was funded in part by a grant by the American Egg Board.

In this study eggs were sold by the dozen but each carton was individually weighed and priced accordingly. There were no differences in prices per pound among the various egg sizes. The resulting prices per dozen ranged from a low of 52 cents for an eighteen ounce carton of small eggs to 81 cents for a 28

ounce carton of Extra Large eggs. The price per pound during the experiment was 46 cents per pound. Prior to the test large eggs were selling for 73 cents per dozen (46 cents per pound); medium eggs were selling for 68 cents per dozen (48 cents per pound); small eggs were selling for 55 cents per dozen (45 cents per pound).

The object of the test was to determine how consumers would react to eggs priced by the pound. A substantial majority (75%) said tht all foods ought to show their price per pound. Eighty-three (83%) percent thought eggs were a good protein food value when compared to meat. However, only forty-one (41%) percent thought eggs should be actually priced by the pound and eighty-two (82%) percent felt that eggs should continue to be sold by the dozen.

These results corroberated some of the findings of a study conducted by Mr. David Clifton of the Georgia Tech Engineering Experiment Station in 1974. That study found that consumers did not look favorably upon any changes in the standard sizing and packaging of eggs.

DON'T PRICE BY THE POUND, MARKET BY THE POUND

The conflicting desires of consumers who on one hand want to know the price per pound of eggs and on the other hand look with great displeasure upon any change to the standard sizing

and packaging methods presents a considerable problem to the egg industry. In addition, most of the studies undertaken so far examine actual pricing by the pound. The pricing and sale of eggs by the pound entails additional handling and new equipment, both of which will raise the cost of eggs.

To resolve these problems, the marketing rather than the actual sale and/or pricing of eggs by the pound is recommended. The approximate price of eggs per pound can be prominently displayed such that consumers can both compare the price of eggs with other foods and also compare the price of eggs among the various sizes. This can be done by placing signs at the point of sale. The cost of such signs is negligible. In addition, such an approach will entail no new equipment and no additional handling and hence no extra cost to the producers. The ability of producers to make consumers aware of price difference among the various sizes of eggs by showing different per pound prices should help a great deal in resolving the chronic problem of producing a volume of eggs in the various sizes which is different from the demand for those various sizes (the supply/demand mix mismatch).

The Clifton study indicated that buyers were very inflexible in their size choices. Consumers habitually buy a given size. The Kansas State study indicated a very low awareness on the part of consumers as to the actual weight of a dozen eggs of any size. However, if consumers are aware of

per pound price difference among egg sizes there is an excellent chance that they will gravitate toward the best buy. It is recommended that a study be undertaken to obtain at least a quantitative defintion of the price elasticity of eggs relative to each other.

ONE STEP AT A TIME!

It is not recommended that any money be expended on a "definitive" study to quantitatively determine price elasticity at this time. The first step is to see if the concept of marketing "Eggs by the Pound" as opposed to pricing or selling eggs by the pound has merit. If consumer discussion indicates favorable reaction to such a concept and if there is an indication that a cost effective pricing structure can be developed to alleviate the supply-demand mix mismatch, then at that time it will not be too difficult a matter to either conduct a test or to simply gather and refine pricing data at locations which start to display per pound costs as a result of a positive reaction on the part of consumers to a limited test.

Appendix A

A list of Sources of Information on "EGGS BY THE POUND":

PRICING AND SELLING EGGS BY THE POUND AT RETAIL: Kansas Agricultural Experiment Station, Kansas State University, Manhattan, Kansas.

SOME PRACTICAL METHODS FOR PRICING EGGS BY WEIGHT: Egg Industry, Dec. 1970, p. 34.

EGGS BY THE POUND - OR PER KILO?: Canadian Poultry Review, May 1973.

PRICING EGGS BY THE POUND: E. P. Roy, Louisiana State Univeristy, Bulletin 555, June, 1962.

MERCHANDISING MINI LESSON: Egg Industry, September, 1973, p 24.

GIMMEE A POUND OF EGGS: Progressive Farmer, January 1976.

AN ANALYSIS OF MERCHANDISING METHODS FOR EGGS: David S. Clifton, Industrial Development Division, Engineering Experiment Stateion, Georgia Institute of Technology, June 1974.

A TEST MARKET OF EGGS BY THE POUND

A TEST MARKET OF EGGS BY THE POUND

For many years the concept of pricing eggs by the pound has been talked about in the egg industry. A number of different approaches have actually been tested.

There are two major problems with pricing eggs by the pound. First, consumers have demonstrated resistance to any change to the standard packaging and pricing by the dozen in use today. And, second, actually pricing eggs by the pound requires additional equipment and handling which means additional expense.

However, the industry has also observed the trend toward unit pricing and has observed the confusion of shoppers as they try to figure out which size of egg is the "best buy". In addition, the industry has traditionally faced the problem of producing a mix of eggs that is different from the mix demanded by consumers (the supply/demand mix mismatch).

In order to help alleviate the problems caused by non-unit pricing and by the supply/demand mix mismatch, the concept of marketing rather than pricing eggs by the pound was developed. A test market was undertaken to investigate the effectivenss of the concept. The hypothesis, structure and results of that test are reported below.

HYPOTHESIS:

The prominent display of the approximate price per pound of the various sizes of eggs will allow consumers to

effectively compare the relative prices among the various sizes of eggs and consumers will then tend to purchase the least expensive size in terms of price per pound.

PRIMARY PURPOSE

If consumers can be induced to purchase the egg size with the lowest effective price per pound, the supply/demand mix mismatch problem can be alleviated through differential pricing.

SECONDARY PURPOSE

To allow consumers to compare the price of eggs to other food stuffs such as meat and cheese and thereby induce consumers to substitute eggs for more expensive foods.

THE STRUCTURE OF THE TEST

An ideal test market would be made over an extended period of time (two to four months) and be conducted in perfectly matched pairs of stores. In each matched pair, one store would conduct the test and the other would conduct business as usual. The stores in each pair would have identical markets in terms of consumer demographics and identical sales volumes and patterns. The impact of the test would then be easily measured by simply comparing the sales statistics for one store in a pair to the other.

Finding such pairs of stores, however, is practically impossible. Obtaining the permission and co-operation of the

stores is also a difficult matter. In order to execute the "Marketing of Eggs by the Pound" test market in a timely manner, the test, of necessity, was carried out under acceptable but less than ideal conditions.

The stores which gave their approval to the conducting of the test on their premises were the Ogletree's Stores, on Roswell Road and Dunwoody Village. Though the two stores used in the test were within a few miles of each other there were marked differences in the demographics of the shoppers. Because of these differences the concept of a parallel test was abandoned and a serial test was designed.

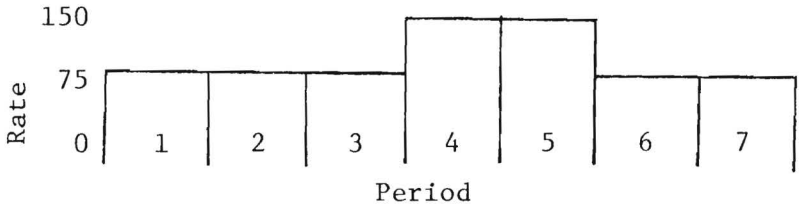
Egg sales data on each store was gathered and recorded every day for three weeks (See Exhibit A showing sample inventory form). After three weeks, when the general sales pattern for each store was fairly well defined, the price per pound information was added to the display cases (See Exhibit B showing sample pricing strips and Exibit C showing color slides of display cases). As prices changed the strips were changed accordingly. Sales Data was gathered for two more weeks under these conditions. At the end of the two week period, the strips were removed. Sales data was then gathered for an additional two week period.

The example below shows how such a test can work. During periods 1, 2, and 3 the rate is 75. A variable is intorduced in period 4 and 5 and the hypothetical rate changes to 150.

ROSWELL STORE

	Medium		Large		Extra Large		Jumbo		
	¢ per doz	doz sold	¢ per doz.	doz sold	¢ per doz	doz sold	¢ per doz	doz sold	TOTAL WEEKLY SALES
M 3-1									
T 3-2			INVENTORY IMPROPERLY TAKEN - NO VALID DATA						
W 3-3									
T 3-4									
F 3-5									
S 3-6									
M 3-8	70	6	73	28	72	13	74	29	
T 3-9		3		83		18		25	
W 3-10		4	70	15		11		14	
T 3-11		0		80		32		61	
F 3-12		5		67		29		40	
S 3-13		6		90		62		33	
		24		363		165		202	754
M 3-15	65	3	70	60	72	33	74	28	
T 3-16		9		62		11		20	
W 3-17		7		60		18		42	
T 3-18		1		80		30		38	
F 3-19		20	71	35	73	97	75	112	
S 3-20		6		104		47		46	
		46		401		236		286	969
M 3-22	65	6	71	21	73	34	75	23	
T 3-23		1		62		64		30	
W 3-24		4		52		10		17	
T 3-25		5		75		13		40	
F 3-26	63	9		74		30		47	
S 3-27		10		90		53		51	
		35		374		204		208	821
M 3-29	63	4	71	87	73	24	75	22	
T 3-30		4		49		31		61	
W 3-31		8		74		45		18	
T 4-1		6		67		34		26	
F 4-2		12		71		42		37	
S 4-3		9		125		53		63	
		43		473		229		227	972
M 4-5	63	6	71	60	73	24	75	30	
T 4-6		8	72	58	74	36	76	23	
W 4-7		7		56		22		21	
T 4-8		4		103		27		36	
F 4-9		0		103		57		45	
S 4-10		22		103		49		64	
		47		483		215		219	964
M 4-12	64	8	72	123	74	104	76	37	
T 4-13		20		83		18		34	
W 4-14		3		101		14		33	
T 4-15		6		130		55		67	
F 4-16		1		125		65		102	
S 4-17		0		180		105		72	
		38		742		361		345	1486

The variable is removed and the rate drops back to 75 during periods 6 and 7. The conclusion of the test would be that the variable changed the rate for 75 and 150.

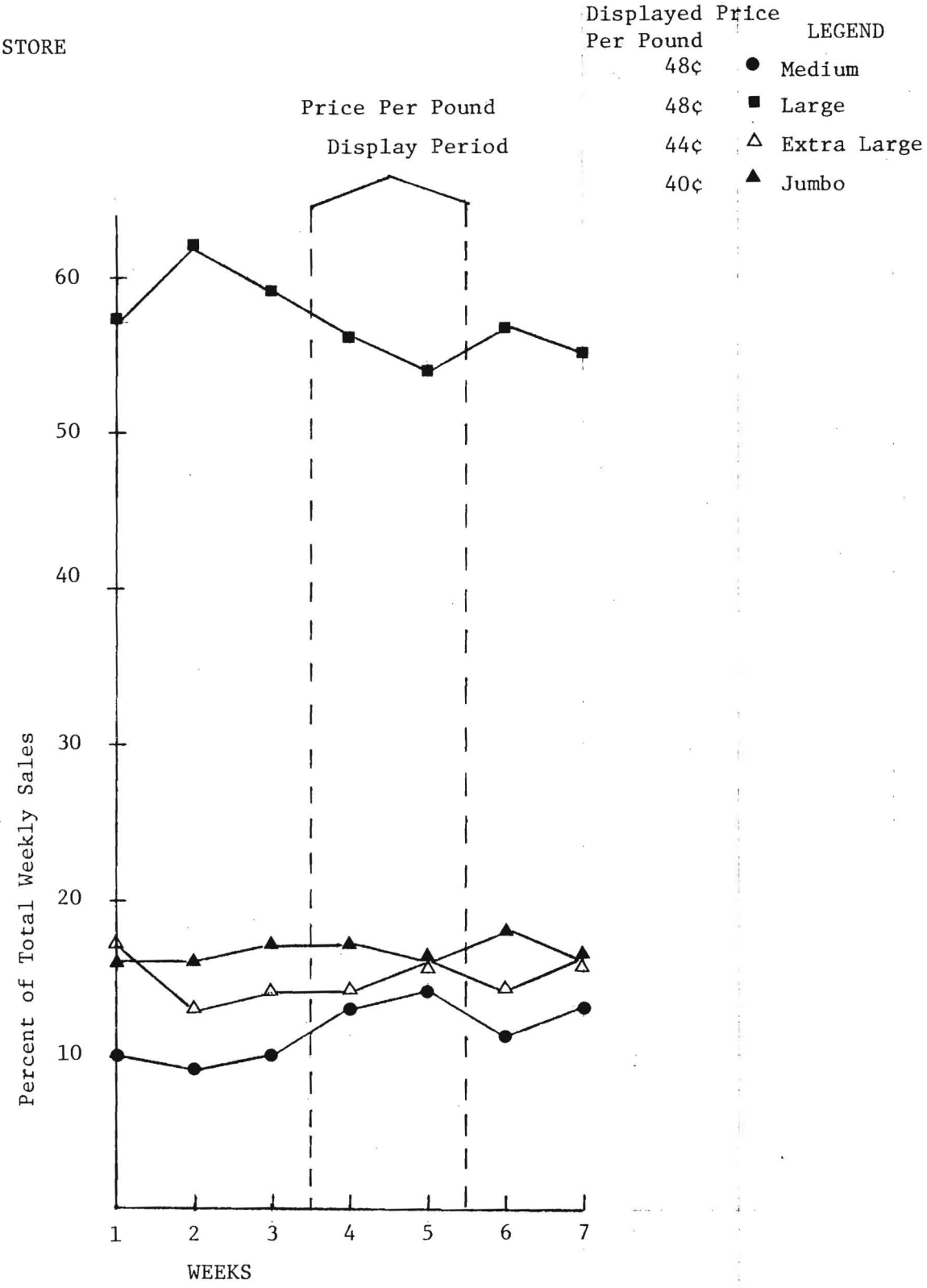


In a "real world" situation test results are seldom that clear. The graphs and charts of the results of the "Test Market of Eggs by the Pound" are given below.

DUNWOODY STORE

	Medium		Large		Extra Large		Jumbo		
	¢ per doz	doz sold	¢ per doz.	doz sold	¢ per doz	doz sold	¢ per doz	doz sold	TOTAL WEEKLY SALES
M 3-1	70	30	73	130	75	36	77	38	
T 3-7		16		67		19		6	
W 3-3		3		116		19		20	
T 3-4		20		215		51		20	
F 3-5		25		115		89		80	
S 3-6		60		240		45		60	
		154		883		259		245	1541
M 3-8	65	15	70	124	72	30	74	36	
T 3-9		15		116		15		24	
W 3-10		27		105		30		12	
T 3-11		18		180		30		36	
F 3-12		15		215		45		50	
S 3-13		37		165		45		78	
		127		905		195		236	1463
M 3-15	64	32	70	145	72	25	74	38	
T 3-16		21		95		20		40	
W 3-17		15		125		45		36	
T 3-18		30		240		60		48	
F 3-19	65	30	71	175	73	30	75	60	
S 3-20		30		150		40		54	
		158		930		220		276	1584
M 3-22	65	30	71	120	73	35	75	36	
T 3-23		15		75		30		24	
W 3-24		30		120		30		35	
T 3-25		30		165		35		28	
F 3-26		45		179		50		45	
S 3-27		40		180		35		95	
		190		836		215		263	1507
M 3-29	63	35	71	130	73	40	75	40	
T 3-30		25		95		25		35	
W 3-31		40		135		45		40	
T 4-1		35		180		60		35	
F 4-2		50		195		55		50	
S 4-3		45		185		45		70	
		230		920		270		270	1690
M 4-5	63	15	72	124	74	30	76	36	
T 4-6		15		116		15		24	
W 4-7		27		105		30		12	
T 4-8		18		180		30		36	
F 4-9		50		235		70		75	
S 4-10		63		195		65		110	
		188		955		240		293	1676
M 4-12	64	50	72	135	74	55	76	40	
T 4-13		45		155		65		60	
W 4-14		30		140		65		55	
T 4-15		45		198		70		61	
F 4-16		95		265		78		115	
S 4-17		55		437		57		65	
		320		1330		390		396	2436

DUNWOODY STORE



ROSWELL STORE

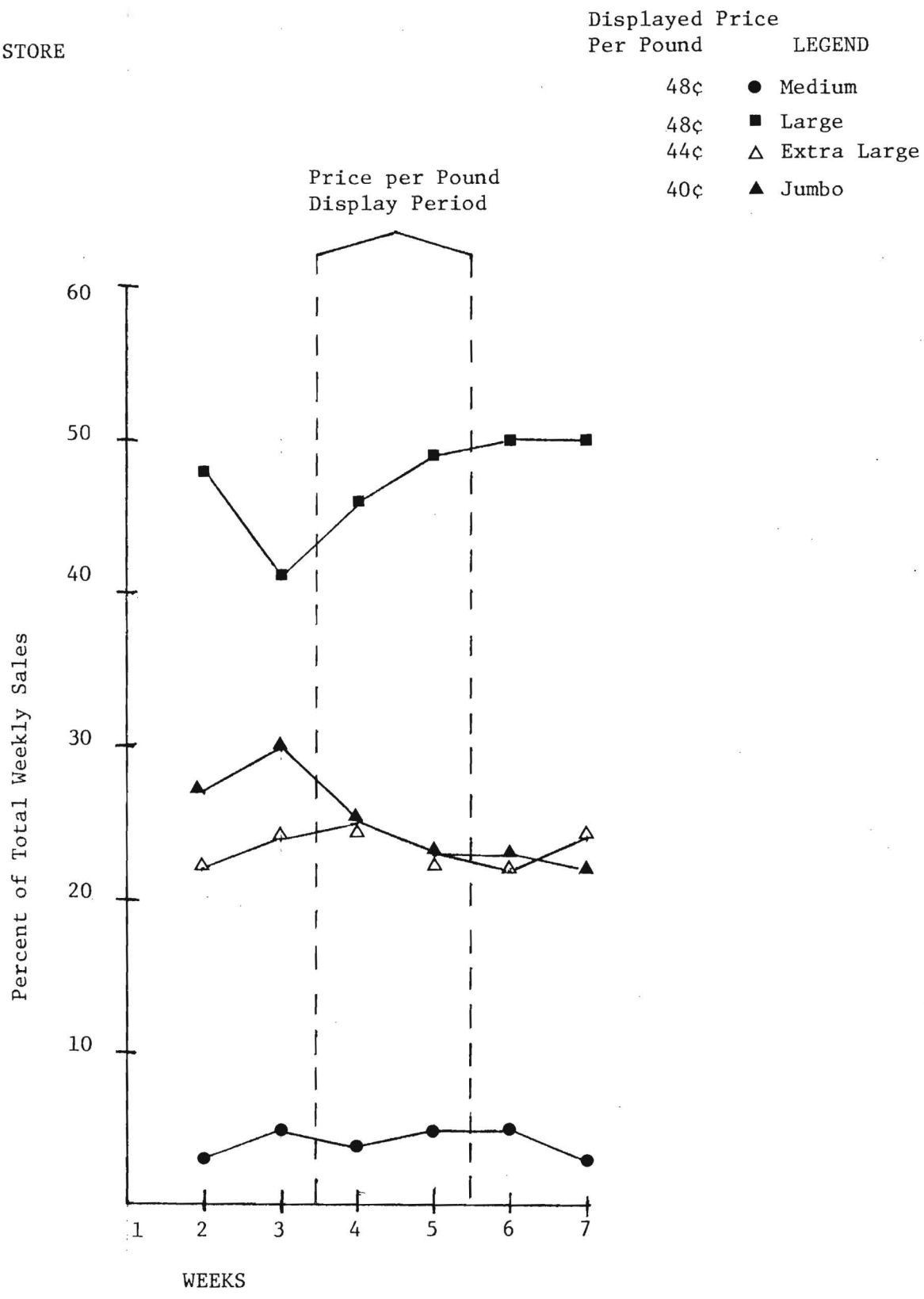


EXHIBIT "A"

MEDIUM	Price		Quantity			
	doz	lb	stg	dis	del	sold
3½ - 2x5						

LARGE	Price		Quantity			
	doz	lb	stg	dis	del	sold

EXTRA-LARGE	Price		Quantity			
	doz	lb	stg	dis	del	sold

JUMBO	Price		Quantity			
	doz	lb	stg	dis	del	sold

EXHIBIT A

CONCLUSIONS:

The results of the test market do not yield any conclusive results. Despite the existence of a 20% price per pound differential between the most expensive and least expensive size of eggs there was no statistically significant size preference shift demonstrated by the consumers.

It is possible that a price differential greater than 20% is necessary to induce consumers to shift from their normally preferred size to an alternate size. It is also possible that consumers did not fully understand the price differences and hence did not react to them. Comments reported by store personnel, however, indicated that consumers did understand the pricing.

Another possibility is that consumers did not have sufficient exposure to the price by the pound stickers to change their buying habits. Egg purchasers in the stores used in the test generally bought eggs once a week. The price per pound stickers were in place for two weeks hence average consumers were exposed to the information only twice. It is very likely that the average egg buyer needs more exposure to the approximate price per pound information in order to react to it enough to change the habitual size preference.

If consumers did not demonstrate any dramatic positive reaction to the test, neither did they respond negatively to

having the approximate price per pound information displayed. Far more favorable comments were reported than were negative comments. The few negative comments that were reported focused on a confusion about seeing two sets of prices. The confusion was not unlike that which results from seeing weights displayed in both pounds and kilograms.

RECOMMENDATIONS BASED ON TEST

Though the test did not establish even an approximate elasticity of demand for the various sizes of eggs it is recommended here that additional formal testing <u>not</u> be undertaken. However, it <u>is</u> recommended that price per pound information be displayed on an industry wide basis. The cost is negligable and the potential long term benefits in terms of increasing consumer's awareness of the economy of eggs as opposed to other foods is great.

73¢
PER DOZEN

GRADE "A" EXTRA LARGE

IS LESS
THAN

44¢
PER POUND

75¢
PER DOZEN

GRADE "A" JUMBO

IS LESS
THAN

40¢
PER POUND

63¢
PER DOZEN

GRADE "A" MEDIUM

IS LESS
THAN

48¢
PER POUND

EXHIBIT B

IV. CONTINUING RESEARCH

Research projects for poultry waste utilization and energy conservation are on-going programs and will continue through the next year under Research Project A-1879. The work for the egg marketing study is completed. Also Research Project A-1879 will include further research into the application of solar energy to broiler house heating and a study of the increased mechanization of whole bird packaging in the broiler processing plant.

The anticipated research objectives for each of the continuing programs are as follows:

Poultry Waste Utilization: It is anticipated that work will continue over the next few years to determine the economic viability of an anaerobic digestor of poultry waste. Under Research Project A-1879 that continues through August 1977, field operation of the pilot facility will continue to determine the effects of feedstock throughput rate, solids settling, bottom loading and several modes of digestor operation on gas composition, gas production and effluent quality.

Energy Conservation in the Poultry Industry: This program will continue to monitor results of several installed demonstration programs and to provide technical assistance to the industry in analyzing individual energy problems and deciding on modifications.

Solar Energy Application to the Poultry Industry: Data will be collected from the recently constructed collector system located at a broiler house in Cumming, Georgia during the winter of 1976-77. From this data will be determined the quantity of heat and percentage of total heat requirement furnished to the broiler house. Engineering design of a system to fit most broiler houses will be initiated.

Mechanization of Whole Bird Packaging: This program will include consulting with industry personnel and manufacturers with the purpose of developing the conceptual design of a system to group birds into like sizes, place in a container, weigh the contents, fill with ice or carbon dioxide, cover and move to storage. It is anticipated that this work will accelerate the development of such equipment by the poultry equipment manufacturing industry.