THE ECONOMICS OF FOOD IRRADIATION AND THE GRAY*STAR™ FOOD IRRADIATOR

by Albert S. Marulli, Agricultural Trade Services

According to most reliable sources, the use of radiation for processing foods has successfully overcome the perceived hurdle of consumer acceptance. With the knowledge that all major health organizations and U. S. regulatory bodies have endorsed the use of irradiation as an effective and safe process to reduce the incidence of food-borne disease and as a reliable method to control quarantine pests, the general public appears to be ready, and in some ways anxious, to see irradiated foods on the supermarket shelves.

The primary focus of attention is now on the food industry itself. Will the industry employ this technology to meet increasing consumer demand for food products that are free of harmful pathogens? Will the industry use this technology for the control of prohibited plant pests that are carried in or on food products as they are transported in interstate and international commerce?

According to the National Food Processing Association (NFPA), the voice of the $430 billion food processing industry, there is a considerable movement towards the use of radiation processing among its members. The NFPA is actively engaging government regulators by promoting the enactment of legislative measures that would enhance the commercialization of this process. Their most recent success was in the area of labeling which the NFPA believes "will help advance the use of this important food safety tool". This regulatory reform revises labeling requirements so that irradiation labeling no longer resembles 'warning labels'. Under the amended regulation, foods will continue to be labeled but irradiation information need be no more prominent than the ingredient declarations.

In a recent industry news report, three major food processors publicly announced their support for food irradiation namely; Cargill, ConAgra and IBP. These food processing companies are now considering the manner and equipment by which this technology may be implemented in their plants. Obviously, one of the most critical factors they must consider is the economic feasibility of the process.

This study deals with that critical economic issue as it pertains to the seasonal utilization of the **Gray*Star™ Food Irradiator** when irradiation is applied as a quarantine treatment. Two cost analysis sheets, which were produced using **the software** program **Gray*Star Cost Analyzer**, illustrate the closely approximated cost to treat fruit commodities from Hawaii using the minimum dose of 250 Grays as required under current USDA quarantine regulations. The production levels and seasonal length cited in the study were chosen as an example and may or may not directly coincide with actual production volumes or seasonal length in Hawaii.

Basic features of **the Gray*Star™ Food Irradiator** that contribute to the economic feasibility of the process for insect disinfestation and for other food safety applications are also highlighted in this report.

DETERMINING RADIATION PROCESSING COSTS WITH THE GRAY*STAR COST ANALYZER

Components used in determining cost per unit of product in this study includes **amortization, shipping and installation, maintenance, labor** and **overhead.** Costs will vary but the approximations are close and actual costs could be slightly higher or slightly lower.

Radiation processing costs are closely related to **the reauired minimum dose** and to the **average product density.** Both are a major factor in the amount of time the product must remain under exposure in the radiation cell. **The amount of product** processed seasonally or yearly also has a direct bearing on the cost per unit of product.

Exhibits A. and B. on the following pages illustrate how the processing cost is determined taking into account all the factors outlined above.

COST ANALYSIS SUMMARY

Exhibit	Season	Hours/Days of Operation	Total operating hours	Product processed
A.	16 weeks	12 hours/day 5 days/week	960 hours	10,900,000 lbs.
			Processing cost	2.0 cents/lb.
B.	16 weeks	20 hours/day 6 days/week	1920 hours	21,800,000 lbs.
			Processing cost	1.14 cents/lb.

The GRAY*STAR™ FOOD IRRADIATOR is specifically designed:

(1) for use in the packing house, processing plant or cold storage distribution warehouse to eliminate the costs associated with transporting the commodity to a centralized facility.

(2) to be inherently safe and to be operated without the need for electronic interlocks or other safety systems.

(3) to be operated with unskilled low-cost labor under the general supervision of the operations manager.

(4) to operate throughout the entire season and to be secured and left unattended when in the idle mode.

(5) to process a full forty by forty-eight pallet with a product height of forty-eight inches within a max/min ratio of 2 to 1.

(6) to be operated on a seasonal or yearly basis with minimal low-cost maintenance.

Cost Analyzer

GRAY * STAR

Based on **density** of .40

QUARANTINE TREATMENT
Cost per lb. based on seasonal
Date:on of 10,900 02-Sep-98
Version operation o 2.0
16 weeks.

Product: **Various from Hawaii**
Purpose: **Disinfestation**
Prepared: Agricultural Trade **Services**

Unigray ? > **Y**

INPUT PARAMETERS

[1]	Unit Purchase **Price**	**$1,500,000 dollars**
[2]	Shipment + Installation	$200,000 dollars
[3]	**Initial Cesium-137** Loading	2,800, ooo **curies**
[4]	Minimum Dose Required	250 grays
[5]	Maximum Dose Allowed	**1,000 grays**
[6]	Average Bulk Product **Density**	0.40 **grams/cc**
[7]	Labor Rate	**$10.00 dollars/hour**
[8]	Overhead	100 percent
[9]	Workday	12 hourslday
[10]	Workweek	5 days/week
[11]	Load-Unload Time	2.0 minutes
[12]	Season Length	112 days/year
[13]	Year of Production	1 year
[14]	Maintenance & Repairs	$6,000 dollars/year
[15]	Finance Term	**15.0 years**
[16]	Finance Interest Rate	10.0 percent
[17]	Product Stack Height	48 inches
[18]	Product Stack Length	46 inches
[19]	Product Stack Width	40 inches

TECHNICAL DATA

[20]	Product Weight on Pallet	**1,333 pounds**
[21]	Minimum Dose Received	250 grays
[22]	Maximum Dose Received	505 grays
[23]	Percent of Max Dose Allowed	50.5 percent
[24]	Max / Min Achieved	2.02 **(U)**
[25]	Irradiation Time	5.0 minutes
[26]	Total Cycle Time (minutes)	7.0 minutes
[27]	Total Cycle Time (hours)	**0.12 hours**
[28]	Annual Processing Time	**960 hours/year**
[29]	Minimum Dose Rate (grays)	49.6 grays/minute
[30]	Minimum Dose Rate (rads)	296,880 reds/hour
(3 1	J Radiation Utilization Factor	5.59 percent
[32]	Overall Utilization Factor	3.99 percent
[33]	Cesium-137 Remaining	**2,768,038** curies
[34]	Annual Unused Capacity	89 percent
[35]	10th Year Production Output	**86** percent

COST ESTIMATION

2.00 cents/pound
4.41 cents/kilogram
0.0200 **$/pound**
0.50 $/cubic foot
39.96 **$/ton**
44.06 **$/metric** ton
26.64 **$/pallet**
216,629 **$/year**

HOURLY PRODUCTION

11.398 pounds
5,170 kilograms
5.70 short tons
5.17 metric tons
8.55 pallets
456 cubic feet
0.3 truckloads

includes overtime

DAILY PRODUCTION

136.777 pounds
62,028 kilograms
68.4 short tons
62.0 metric tons
102.6 pallets
5,471 cubic feet
3.4 truckloads

YEARLY PRODUCTION

10,942,131 pounds
4,963,241 kilograms
5,471 short tons
4,963 metric tons
8,207 pallets
437,685 cubic feet
274 truckloads

costs	$/year	percent
Labor	9,600	4.4
Overhead	9,600	4.4
Mainten.	6,000	2.7
Unit	100,000	45.7
Interest	93,429	42.7
TOTAL	**$218,629**	100.0

EXHIBIT A

*If the **Gray *Star™ Food Irradiator** were operated at full capacity, that is 24 hours **a day, 3.50** days per year, the volume processed would be **95,700,000 lbs. at less than onehalf cent per lb.***

GRAY*STAR, inc. 200 Valley Road Suite 103 Mt Arlington, NJ 07856 (973) 398 3331 Fax (973) 398 8310

Agricultural Trade Services One Springfield Street Chicopee, MA 01013 (800) 655 2527 Fax (413) 592 8202

Cost Analyzer

GRAY ✱ STAR

Based on density of .40

QUARANTINE TREATMENT

Cost per lb. based on seasonal production of 21,800,000 lbs
Seasonal operation of irradiator 16 weeks.

Product: **Various from Hawaii**
Purpose: **Disinfestation**
Prepared: **Agricultural Trade Services**
Date: **29-Aug-98**
Version: 2.0

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INPUT PARAMETERS

[1]	Unit Purchase Price	$1,500,000	dollars
[2]	Shipment + installation	$200,000	dollars
[3]	Initial Cesium-137 Loading	2,800,000	curies
[4]	Minimum Dose Required	250	grays
[5]	Maximum Dose Allowed	1,000	grays
[6]	Average Bulk Product Density	0.40	grams/cc
[7]	Labor Rate	$13.00	dollars/hour
[8]	Overhead	100	percent
[9]	Workday	20	hours/day
[10]	Workweek	6	days/week
[11]	Load-Unload Time	2.0	minutes
[12]	Season Length	112	days/year
[13]	Year of Production	1	year
[14]	Maintenance & Repairs	$6,000	dollars/year
[15]	Finance Term	15.0	years
[16]	Finance Interest Rate	10.0	percent
[17]	Product Stack Height	48	inches
[18]	Product Stack Length	48	inches
[19]	Product Stack Width	40	inches

TECHNICAL DATA

[20]	Product Weight on Pallet	1,333	pounds
[21]	Minimum Dose Received	250	grays
[22]	Maximum Dose Received	505	grays
[23]	Percent of Max Dose Allowed	50.5	percent
[24]	Max / Min Achieved	2.02	(U)
[25]	Irradiation Time	5.0	minutes
[26]	Total Cycle Time (minutes)	7.0	minutes
[27]	Total Cycle Time (hours)	0.12	hours
(28)	Annual Processing Time	1,920	hours/year
[29]	Minimum Dose Rate (grays)	49.8	grays/minute
[30]	Minimum Dose Rate (rads)	298,880	rads/hour
[31]	Radiation Utilization Factor	5.59	percent
[32]	Overall Utilization Factor	3.99	percent
[33]	Cesium-137 Remaining	2,768,038	curies
[34]	Annual Unused Capacity	77	percent
[35]	10th Year Production Output	86	percent

COST ESTIMATION

1.14 cents/pound
2.51 cents/kilogram
0.0114 $/pound
0.28 $/cubic foot
22.79 $/ton
25.12 $/metric ton
15.19 $/pallet
249,349 $/year

HOURLY PRODUCTION

Includes overtime

11,398 pounds
5,170 kilograms
5.70 short tons
5.17 metric tons
8.55 pallets
456 cubic feet
0.3 truckloads

DAILY PRODUCTION

227,961 pounds
103,380 kilograms
114.0 short tons
103.4 metric tons
171.0 pallets
9,118 cubic feet
5.7 truckloads

YEARLY PRODUCTION

21,884,262 pounds
9,926,482 kilograms
10,942 short tons
9,926 metric tons
16,413 pallets
875,370 cubic feet
547 truckloads

COSTS	$/year	percent
Labor	24960	10.0
Overhead	24,960	10.0
Mainten.	6,000	2.4
Unit	100,000	40.1
Interest	93,429	37.5
TOTAL	$249,349	100.0

EXHIBIT B

*If the Gray ***Star™ Food Irradiator** were operated at full capacity, that is 24 hours a day, 350 days per year, the volume processed would be **95,700,000 lbs. at less than onehalf cent per lb.***

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