CLEANING WHEAT AT A COUNTRY ELEVATOR

A Case Study

by

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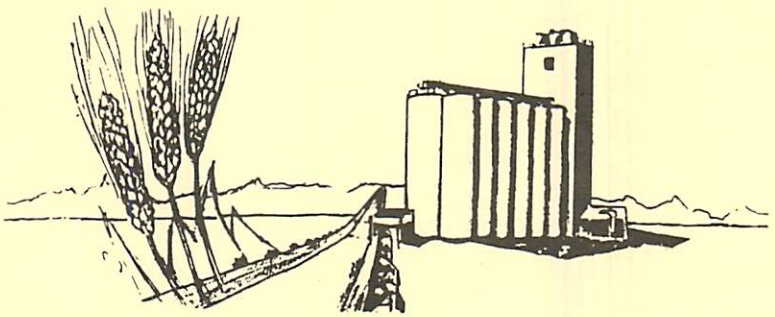

Kansas Wheat Commission and
Kansas Agricultural Experiment Station
Manhattan, Kansas

December 1984

PREFACE

The author wishes to thank Mr. Gary Gilbert for supplying information on the number of bushels of wheat shipped, on grain inspection results, on the amounts of material removed by screening and aspiration, and on the costs of investment and operation of a screener and an aspirator.

Additionally, the continued support and encouragement of the Kansas Wheat Commission to study the impact of removing dockage from wheat is greatly appreciated. The farmer commissioners are to be commended for their help in documenting the impacts of dockage removal through their funding of projects like this one and by their continued support of the International Grains Program.

This author wishes to acknowledge the foresight of Mr. Myron Krenzin, former administrator and Mr. John Dukelow, former agricultural marketing specialist with the Kansas Wheat Commission, who earlier proposed such a study. I am sure Mr. Krenzin and Mr. Dukelow would agree that this study is only a part of the needed documentation and analysis of the economic and marketing ramifications of dealing with wheat dockage in the United States and world wheat market.

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INTRODUCTION

The pros and cons of removing dockage from wheat have been debated for years. This debate includes the level of dockage that is considered excessive. Dockage amounts are usually considered excessive by the grain trade when they reach 0.5 percent by weight. This is indicated by the general practice of reducing the weight of a shipment by the amount of dockage when it is 0.5 percent or greater.

Country elevator operators, who have used aspirators or screeners[2] to remove dockage[3] from wheat, have said the investment in such equipment has paid for itself, sometimes in one year if there were excessive amounts of dockage in that harvest of wheat delivered by farmers. This is a case study that analyzes market recognition of dockage levels and evaluates the costs and returns of screening and aspiration systems used by one country elevator operator. Detailed data were provided on the weight of dockage removed prior to shipment, the operating costs, and transportation rates for shipping wheat. Other data provided were the official grades, grade factor determinations, dockage levels of the wheat shipped from the elevator, delivered weights at the terminal elevator, and prices received.

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[1]Dr. Keith Behnke, Associate Professor, Department of Grain Science, Mr. Joe Tiao, Instructor, Department of Economics, provided immeasurable advice and assistance. Mr. Tiao developed the computer analysis program. Mr. James Sterns, Student Assistant, helped in the analysis. This study was financed by the Kansas Wheat Commission. Contribution 85-251-D from the Kansas Agricultural Experiment Station.

[2]A screener is a system using a set of screens to remove unwanted material from the wheat, whereas an aspirator uses air to blow out this material as it moves around a set of baffles.

[3]See Appendix B for the official definition of dockage and foreign material under the U.S. Grain Standards Act.

STUDY PROCEDURES

In this case study, a rotary screener was operated at 800 bushels per hour for 56 truckload shipments and an aspirator was operated at 1,500 bushels per hour for 22 truckload shipments. Ninety-eight truckload shipments that were not screened or aspirated were used as a comparison against those that had dockage material removed by screening or aspiration.[4] All of the shipments of hard red winter (HRW) wheat were from the 1982 crop in the same geographic area, within 30 miles of the elevator. The average unloading weight of truck shipments at the terminal elevator was 53,420 pounds of the original outbound weight from the country elevator, 1.17 percent was removed by the rotary screener and 0.76 percent by the aspirator.

This analysis assumed that all of the wheat was essentially the same prior to screening or aspiration. In using statistical tests to compare the inspection results of the unscreened, screened, and aspirated shipments, screening and aspiration significantly increased the test weight, decreased dockage percentages, and decreased the price discounts assessed on the shipments. Screening decreased the percentage of shrunken and broken kernels, whereas aspiration did not. Although further studies involving more rigorous analytical procedures applied to more shipments could likely change the figures, it is believed that these data are sufficiently documented to permit valid conclusions.

EFFECTS ON GRADE LEVELS AND DOCKAGE PERCENTAGES

Grade Levels

Screening and aspiration improved the numerical grade of the shipments. None of the unscreened shipments graded

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[4] The 98 shipments that were not screened or aspirated were shipped prior to the installation of the screener. Later, the aspirator replaced the screener. The shipments through the period of study were taken sequentially. Subsequent analysis will be needed to develop a method of representative sampling before the wheat enters the aspirator and after the wheat passes through the aspirator.

U.S. No. 1; over two-thirds graded U.S. No. 2; and nearly one-third graded U.S. No. 3. However, of the screened shipments, 3.5 percent graded U.S. No. 1; 87.5 percent U.S. No. 2; and only 8.9 percent graded U.S. No. 3. Of the aspirated shipments, 86.5 percent graded U.S. No. 2, and 13.5 percent U.S. No. 3, after the adjustment was made for heat damage in some of the aspirated shipments.[5] (See Table 1)

Table 1
Percentage Distribution of the HRW Wheat
Truck Shipments by Grade, 1982

Grades	Unscreened		Screened		Aspirated	
	Bu.	(%)	Bu.	(%)	Bu.	(%)
U.S. No.1	0	0.00	1,753	3.54	0	0.00
U.S. No.2	58,200	67.41	43,301	87.54	17,626	86.49
U.S. No.3	28,142	32.59	4,410	8.92	2,754	13.51
TOTAL	86,342	100.00	49,464	100.00	20,380	100.00

DOCKAGE PERCENTAGE

Wheat shipments that were screened or aspirated had lower dockage percentages. Among the unscreened shipments, the certified dockage percentages ranged from 0.0 to 3.5 percent.[6] Of these shipments, 9.2 percent had zero dockage, while 58.2 percent had 0.5 percent, and 32.6 percent had 1.0 percent dockage or more.

Of the screened wheat shipments, 62.5 percent were certified with zero percent dockage and 37.5 percent with 0.5 percent dockage. Of the aspirated shipments, 86.4 percent were certified as having zero percent dockage and 13.6 percent as having 0.5 percent dockage. (See Table 2 for a summary of dockage percentages.)

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[5] Since aspiration does not affect the level of heat damaged kernels, the effect of such kernels on the grade and price discounts was eliminated by making the heat damaged kernels percentage the average of those shipments without heat damage.

[6] Certified dockage percentages are the result of rounding down to the nearest half percent. For example, 0.0 to 0.49 percent is certified as zero; 0.5 to 0.99 is certified as 0.5 percent.

Table 2
Percentage Distribution of the HRW Wheat Truck
Shipments by Different Levels of Dockage Percentages, 1982

Certified Dockage Levels	Unscreened Shipments		Screened Shipments		Aspirated Shipments	
(%)	(Number)	(%)	(Number)	(%)	(Number)	(%)
0.0	9	9.2	35	62.5	19	86.4
0.5	57	58.2	21	37.5	3	13.6
1.0	6	6.1				
1.5	9	9.2				
2.0	15	15.3				
2.5	1	1.0				
3.0	0	0.0				
3.5	1	1.0	—	—	—	—
TOTAL	98	100.0	56	100.0	22	100.0

ECONOMIC ANALYSIS

Two methods were used to appraise the economic impact of removing dockage from wheat by screening or aspiration. These were profit and loss or break-even analysis under various conditions and pay-back period.

Break-even Analysis

The profit received from selling unscreened wheat to a terminal was compared against the profit from selling screened or aspirated wheat to the same terminal. Conditions were simulated and varied to discover how much value had to be attributed to the screenings or liftings[7] in order for the screening or aspiration operation to break-even.

[7] Liftings consist of material removed or lifted from wheat by aspiration.

The relevant variables used in the analysis to simulate different conditions were wheat sales, earnings from screenings or liftings, transportation cost of the wheat shipments, and the operating costs of a screener or an aspirator.

It is important to note here that the values used for the screenings or liftings were the adjusted variable that allowed for the break-even computation. Values of $2.00, $2.50, and $3.00 per hundredweight were used in the initial analysis before computation of a break-even point and a payback period, since these were the prices that country elevator operators were receiving in 1982. A feed formulating specialist would use a linear program to compute the value of the screenings in mixed feed. Screenings or liftings are considered to have nutritional value of at least 80 percent that of corn.[8]

The market price of screenings is also affected by its own supply. The price of screenings in the future might be higher or lower than the values considered in this analysis and obviously could affect profits. If a reliable supply of screenings were available to the market, prices might be higher than current prices because there would be less frequent changes in feed formulas. It also could be argued that the availability of more screenings or liftings would have depressive effects on the market prices of screenings because of increased supply.

If the latter case existed, it would be useful to know if the cost of screening or aspiration could be covered sufficiently by transportation savings alone. This was the principal reason for using a break-even analysis.

In this study, the cost of transporting the screenings or liftings to the user was zero, since they were used by the elevator operator for swine rations. The net profit to unscreened or nonaspirated wheat shipments included the wheat sales less the transportation costs. The net profit to the screened or aspirated shipments included (1) wheat sales at a higher net price per bushel than unscreened or

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[8] See Appendix C for a comparison of the nutritive value of several samples of the liftings that included shrunken and broken kernels and light-weight material, all of which were removed by aspiration from 1984 wheat crop shipments. Also included is the nutritive value for hard wheat, wheat millrun, and wheat middlings.

nonaspirated wheat because of lower price discounts, (2) transportation savings from not shipping 0.5 percent or more dockage material that receives no returns, (3) value attributed to screenings or liftings, and (4) deducting the cost of aspiration or cleaning. The net profit from the screened or aspirated wheat shipments was compared to the net profit from those shipments that were neither screened nor aspirated.

Prices and costs related to this analysis were:

Wheat price -- $3.65 per bushel less average price discount for unscreened, and aspirated shipments respectively.

Investment Costs:

Annual Interest Rate[9] -- 13.0 percent

Depreciation -- 20 percent of the original value annually

Operating Costs

Screener -- 1.62 cents per bushel
Aspirator -- 1.03 cents per bushel

(See Appendix A for Cost Calculations)

The following list shows the alternative values used in the profit/loss analysis.

Percentage of Dockage Removed[10]
by Screening: 1.17 percent
by Aspiration: 0.76 percent

Annual Bushel Volumes Aspirated or Cleaned -- 250,000 and 500,000 bushels

Transportation Rates -- Truck: 25 cents per bushel and 25 Rail Car-Export: 62 cents per bushel

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[9]Annual interest cost over the lifetime of facilities is based on one-half of 13.0 percent since average depreciated value is only half of the original value and hence the amount of borrowed money used is reduced at the same rate over the life of the investment.

[10]The percentage of dockage removed by screening and aspiration was the weight recorded by the elevator operator, expressed as a percent of the total weight of the grain screened or aspirated.

Values of Screenings -- $2.00, $2.50, $3.00 per hundredweight

A lower value was needed for the liftings to have the aspiration operation break-even than to have the screenings operation break-even. The value of liftings ranged from $0.17 to $1.66 per hundredweight. However, for a break-even point for the screener, the range for the value of screenings was from $3.22 to $4.27 per hundredweight. (See Table 3)

Table 3

Value of Screenings or Liftings Needed to Break-even in Screening or Aspiration Operations for Selected Combinations of Bushels Handled, Screening Rates, and Transportation Rates

Annual Volume Handled and Screened (bushels)	Screening Rate[a] (%)	Transportation Rate (¢ per bushel)	Value of Screenings Needed to Break-even ($ per cwt)
		SCREENING	
250,000	1.17	25	4.27
250,000	1.17	62	3.65
500,000	1.17	25	3.83
500,000	1.17	62	3.22
		ASPIRATION	
(con't)	Lifting Rate[a]	(con't)	Value of Liftings
250,000	0.76	25	1.66
250,000	0.76	62	1.04
500,000	0.76	25	0.79
500,000	0.76	62	0.17

[a]See footnote 10 for how the rate was determined.

Payback Period

The payback method provides a measure to compare how soon alternate, original investments are repaid by the profits. The elevator operator wished to know how soon he would receive sufficient earnings to recover his initial investment. This is especially important since he uses the screener or aspirator only two or three years out of every five years to reduce dockage levels below 0.5 percent.

Different cases of quantity of wheat screened or aspirated, shipping rates, and screening values were simulated. In all, 16 cases were analyzed. The general trend favored a larger original wheat volume, an export shipping rate of 62 cents per bushel, and the operation of the aspirator over the screener.

The most favorable payback period was with the aspirator, listed as case 12A (see Table 4), for 500,000 bushels of wheat, 62 cents shipping rate, and $3.00 per hundredweight for liftings. This case yielded yearly profit of $6,452.37 and a payback period of 14 months. Even at $2.00 per hundredweight (case 10A) for liftings, this case would have yielded the fourth best payback period. The least favorable payback period (case 2S) was with the screener, 500,000 bushels of wheat, 25 cents shipping rate and $3.00 per hundredweight for the screenings. This created a profit of only $222.56 per year and a payback period of 26.2 years.

Table 4

Payback Period for Screener and Aspirator

Case	Original Bushels	Shipping Rate (¢/bu)	Screenings or Liftings ($/cwt)	Savings: Total Net Profit ($)	Payback Period (years)
		SCREENER[a]			
1S[b]	250,000	62	3.00	421.57	13.83
2S	500,000	25	3.00	222.56	26.20
3S	500,000	62	2.50	632.17	9.22
4S	500,000	62	3.00	2387.16	2.44
		ASPIRATOR[c]			
1A[d]	250,000	25	2.00	387.62	19.35
2A	250,000	25	2.50	957.61	7.83
3A	250,000	25	3.00	1527.61	4.91
4A	250,000	62	2.00	1094.40	6.85
5A	250,000	62	2.50	1664.39	4.51
6A	250,000	62	3.00	2234.39	3.36
7A	500,000	25	2.00	2758.79	2.72
8A	500,000	25	2.50	3898.79	1.92
9A	500,000	25	3.00	5038.79	1.49
10A	500,000	62	2.00	4127.38	1.80
11A	500,000	62	2.50	5312.38	1.41
12A	500,000	62	3.00	6452.37	1.16

[a] Percentage of material removed by screening — 1.17 percent and original investment — $5,830.

[b] S=Screener

[c] Percentage of material removed by aspiration —0.76 percent and orginal investment $7,500.

[d] A=Aspirator

GENERAL SUMMARY

1. This study shows that removing dockage to less than 0.5 percent at this country elevator level was economically profitable.

2. The removal of dockage material increased gross proceeds from sales by:

    a) Lowering the price discount for the screened and aspirated shipments.

    b) Creating a new sales market for the removed dockage.

    It is important to note here that this study dealt with relatively small amounts of dockage removal -- 1.17 percent and 0.76 percent. The net profit should be higher if the percentage of dockage removed is greater.

3. Removing dockage material increased the test weight and decreased transportation cost.

4. Removing dockage material increased total cost by increasing operation, depreciation, and interest costs. However, cost increases were less than the combined increases in gross proceeds and savings or reduction in transportation cost.

5. The value of the liftings or screenings calculated to determine the break-even point ranged from $0.17 to $1.16 per hundredweight for the four aspiration cases and from $3.22 to $4.27 per hundredweight for the four screening cases.

6. Net profit attributed to aspiration increased when the volume increased from 250,000 bushels to 500,000 bushels and when the shipping distance increased from the local truck cost of 25 cents per bushel to the unit-train cost of 62 cents per bushel.

COMPARATIVE SUMMARY

Aspiration Versus Screening

1. The screener noticeably reduced the level of shrunken and broken kernels, while the aspirator did not.

2. The screener removed a higher percentage of dockage from the wheat and decreased transportation cost at a greater rate.

3. The aspirator was economically profitable at values for liftings under $2.00 per hundredweight, while the screener was not profitable until the screenings values were between $3.22 and $4.27.

4. The payback period was shorter for almost all the aspiration cases than for all but one of the screening cases. The most favorable payback period for the aspirator was 14 months, whereas the most favorable one for the screener was 30 months.

5. The aspirator had a lower operating cost and removed less material to attain comparable results in decreased dockage levels, so more material was sold as wheat.

APPENDIX A

Operating Cost Calculation

For Aspiration:

250,000 bushels ÷ 1500 bushels per hour = 166.67 hours

166.67 hours x $10 per hour = $1666.67

Shrink loss is 0.1% x 250,000 bushels = 250 bushels x $3.65 = 912.50

$2579.17

$2579.17 ÷ 250,000 bushels = 1.03¢/bushel

Note: The $10 per hour represents labor and energy cost.

For Screening:

250,000 ÷ 800 bushels per hour = 312.5 hours

312.5 hours x $10 per hour = $3125.00

Shrink loss is 0.1% x 250,000 bushels = 250 bushels x $3.65 = 912.50

$4037.50

$4037.50 ÷ 250,000 bushels = 1.62¢/bushel

Note: The $10 per hour represents labor and energy cost.

APPENDIX B

Definition of Dockage and Foreign Material

The official definition of dockage: "All matter other than wheat which can be removed readily from a test portion of the original sample by use of an approved device (Carter Dockage Tester) in accordance with procedures prescribed in the Grain Inspection Manual. Also (included are) underdeveloped, shriveled, and small pieces of wheat kernels removed in properly separating the material other than the wheat and which cannot be recovered by properly rescreening or recleaning."

Foreign material: "All matter other than the wheat which remains in the sample after the removal of dockage and shrunken and broken kernels."

SOURCE: Washington, D.C., United States Department of Agriculture, Federal Grain Inspection Service, Grain Inspection Handbook - Book II., Grain Grading Procedures, January 1, 1980, pages 2-18 and 2-43.

APPENDIX C

Nutritive Value of Liftings from 1984 Wheat Crop Compared with Nutritive Value of Wheat, Wheat Millrun and Wheat Middlings

Item	Moisture	Protein[a]		Fiber[a]		Fat[a]		Ash[a]	
		As is	14% Basis	As is	14% Basis	As is	14% Basis	As is	14% Basis
C[b]-1	10.2	14.6	14.05	4.1	3.91	1.9	1.82	2.4	2.30
C -2	10.2	15.9	15.20	4.4	4.21	1.8	1.72	2.6	2.49
C -3	9.9	15.9	15.15	5.4	5.15	1.7	1.62	3.3	3.15
C -4	10.3	15.1	14.49	5.1	4.89	1.6	1.54	2.9	2.75
C -5	10.4	14.9	14.29	4.0	3.84	1.6	1.53	2.3	2.18
C -6	10.4	16.1	15.45	5.9	5.66	1.7	1.63	3.0	2.85
C -7	9.7	16.8	16.03	11.5	10.95	3.8	3.62	5.5	5.24
C -8	9.8	16.1	15.34	11.9	11.35	4.0	3.81	5.9	5.63
C -9	9.4	16.3	15.48	11.5	10.92	3.6	3.42	5.0	4.75
C-10	9.3	16.1	15.25	11.9	11.28	3.9	3.70	5.0	4.74
C-11	9.3	15.2	14.42	12.4	11.76	2.6	2.47	5.5	5.21
C-12	9.1	15.1	14.29	13.7	12.96	2.6	2.46	6.5	6.15
Total	——	——	179.44	——	96.88	——	29.34	——	47.44
Average	——	——	14.95	——	8.07	——	2.44	——	3.95
Hard Wheat[c]	14.0	——	13.59	——	2.40	——	1.50	——	1.70
Wheat Millrun[c]	12.0	15.0	14.66	8.5	8.31	4.0	3.91	5.5	5.37
Wheat Middlings Standard[c]	12.0	15.5	15.15	7.5	7.33	4.0	3.91	5.5	5.37

[a] As is = Percentage based on sample moisture and 14% Basis = Percentage corrected on standard moisture percentage at 14 percent and protein percent is equal to N x 6.25.

[b] C-1, C-2, ... C-12 = Different samples of liftings aspirated from Kansas wheat shipments.

[c] Data from 1984 Feedstuffs Analysis Table; Minneapolis, MN, Miller Publishing Company, Feedstuffs, March 29, 1984, Page 33.