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Technical Notes: Aspiration Cleaning of Soybeans

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Abstract
Soybean samples containing 0.5 to 4.0% foreign material and 3 to 22% splits were aspiration cleaned at air velocities of 19 m/s (3500 ft/min) and 10 m/s (1970 ft/min). Both airflow rates removed 80% of the total non-soybean material, and removed similar amounts of splits. The high airflow rate removed 1.1% of whole soybeans compared to 0.4% at low airflow rate. At either airflow rate, the aspirator removed less saleable material and more non-grain material than previously reported for screen cleaning. Aspiration could be an acceptable method for meeting reduced foreign material requirements for soybeans.

Keywords
Soybean, Aspirators

TECHNICAL NOTES:

ASPIRATION CLEANING OF SOYBEANS

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ABSTRACT. *Soybean samples containing 0.5 to 4.0% foreign material and 3 to 22% splits were aspiration cleaned at air velocities of 19 m/s (3500 ft/min) and 10 m/s (1970 ft/min). Both airflow rates removed 80% of the total non-soybean material, and removed similar amounts of splits. The high airflow rate removed 1.1% of whole soybeans compared to 0.4% at low airflow rate. At either airflow rate, the aspirator removed less saleable material and more non-grain material than previously reported for screen cleaning. Aspiration could be an acceptable method for meeting reduced foreign material requirements for soybeans.* **Keywords.** *Soybean, Aspirators.*

Aspiration is a method for cleaning grain at high flowrates. Aspiration is used at soybean processing plants to remove hulls and cracked pods just before entering the solvent extraction process. Aspirators separate materials according to terminal velocity, a function of kernel density, shape, and surface roughness. Previous work has shown aspiration to be effective in separating low-nutrient material from corn, but not necessarily according to any size-defined pattern (Al-Yahya et al., 1991). There are no comparable data for soybeans. Because much of the nonbean material is of low bulk density (pods, stems, plant parts) and not well defined by size (Hurburgh, 1994a, b), aspiration could provide an efficient method for production cleaning of soybeans.

OBJECTIVES

The objectives of this study were to:

1. Determine the type of material that would be removed from soybeans using both low and high velocity aspiration.
2. Assess the potential of aspiration for cleaning market soybeans.

MATERIALS AND METHODS

SAMPLES

From a set of 303 market soybean samples provided by Federal Grain Inspection Service (FGIS) field offices, 50 samples, representing a range of foreign material and splits percentages, were selected for aspiration tests. Sample set details were given by Hurburgh (1994a). The official inspection data accompanying the samples were used to make the selection of the aspiration subset.

The samples actually aspirated were 60% divisions (by using a Gamet rotary divider) of the original samples provided by FGIS. The other 40% fractions were used in other research to determine size and material-type distribution of soybeans in market channels.

Aspiration samples weighed 600 to 1000 g each. The 50 samples were divided into two groups of 25 for aspiration at each of low and high airflow rates. Each group of 25 contained foreign material (FM) from 0.5 to 4.0% and splits from 3 to 22%, distributed as evenly as possible over the ranges.

LABORATORY PROCEDURE

A Kice DT-6 multipass variable airflow laboratory aspirator (Kice Industries, Wichita, Kan.) was used to clean the soybean samples. The low airflow setting (nominally 200 on the indicator) was established in preparatory trials as not removing visible amounts of whole soybeans. The high airflow setting (350) was the maximum, unrestricted flow. As reported by Al-Yahya et al. (1990), these settings represented velocities of 19 m/s (3,500 ft/min) and 10 m/s (1,970 ft/min), respectively. We assumed that the calibration curves developed by Al Yahya were still valid.

Grain throughput was set at 500 g in 10 s. This filled, but did not choke, the aspiration column. The inlet slide was locked at this position through the entire experiment.

Samples were weighed, then aspirated once. The throughs were weighed after cleaning. The heavy fraction was then hand-sorted into whole soybeans, split soybeans, corn and other, by the same procedure described by Hurburgh (1994a). The liftings were discarded. The heavies were analyzed because considerable dust and chaff was lost through the aspirator cyclone. We felt that a subtraction of the distribution of the throughs from the previously determined whole sample distribution would be more accurate than an analysis of the liftings.

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Data Analysis

The percentages by type of material for each airflow rate in the aspirated samples were subtracted from the original percentages for each type of material. The differences provided on estimated distribution and amounts in the liftings. One-way t-tests were used to compare amounts removed to 0.0%. Two-way t-tests were used to compare amounts removed between air velocities.

Subsequently, these data were used to estimate the economic value of lost salable material. Because screening data showed that most soybean FM was non-soybean material (as opposed to broken soybeans), we expected that aspiration could reduce FM levels nearly as efficiently as screening.

Results and Discussion

Table 1 shows the results of the aspiration trials, grouped by low versus high airflow rate. The low airflow removed the "other" and splits at the same effectiveness as the high airflow rate. More whole soybeans were lost at the high airflow rate. The 0.7% increase in lost soybeans is about 4¢/bu — a significant loss for a grain handler.

Because there are few splits (< 0.2%) in the FM fraction (as currently defined by the U.S. Soybean Grades), the two percentage points of splits lifted out also would be a loss to a grain handler — about 10 to 12¢/bu. The aspirator, at either setting, was effective at removing non-soybean material (except corn). Approximately 80% of the total "other" material, regardless of size, was removed.

Aspiration probably could be used to meet more stringent FM standards. Approximately one percentage point of non-soybean material was removed. However, considering both whole soybeans and splits, 2 to 2.5% of the salable product was lost. A reclaim cleaner, at additional expense, would be needed to recover this loss. A lower airflow aspiration probably would reduce, but not eliminate, product loss.

However, in comparison with the square-screen data reported by Hurburgh (1994b), the aspirator did not remove appreciably more salable material than a square-screen of inside measure large enough to inscribe an 8/64 in. circle (the size used in the Official Grades to define FM). Neither cleaner matched the grade definitions, and cleanings from either method would have to be recleaned. Presently, little net cleaning of soybeans is needed to meet normal market specifications.

Table 1. Material removed by aspiration of soybeans

Type of Material	Percentage of Original Weight					
	Low Airflow (n = 25)			High Airflow (n = 25)		
	Initial	Final	Removed	Initial	Final	Removed
Soybeans	88.9	88.5	0.4*a†	88.2	87.1	1.1*b
Splits (broken soybeans)	9.3	7.3	2.0*c	10.1	8.1	2.0*c
Corn	0.5	0 4	0.1NS	0.4	0.4	0.0NS
Other	1.3	0.2	1.1*d	1.3	0.3	1.0
	100.0	96.4	3.6	100.0	95.9	4.1

* Significantly different from 0.0 at the 5% level of confidence, as measured by a t-test.

† Across rows, entries with same letter not significantly different at the 5% level of confidence.

NS Not significantly different from 0 0 at the 5% level of confidence.

Conclusions

1. Both low and high velocity aspiration removed 80% of the total non-soybean material in the samples. This is a higher percentage than a screen of any size would remove. The same percentage of split soybeans was removed by both air velocities, but the high velocity removed 0.7% (by mass of original samples) more soybeans than the low velocity.
2. The splits and whole soybean losses represented about 12¢/bu (2.0%) and 16¢/bu (2.5%) for the low and high airflows, respectively, based on $6.00/bu for soybeans.
3. Aspiration followed by recleaning of liftings could be used to meet lowered foreign material factor limits and would remove more non-grain material than screen cleaning. The product losses probably would be no greater than losses from common-sized, square mesh screen cleaners. A complete economic analysis would be needed to estimate the commercial potential for aspiration in grain handling situations.

References

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