# A NOVEL METHOD OF FILTER AID HANDLING

James E. Kusterer, Jr.
Nampa Factory Technical Assistant


**THE AMALGAMATED SUGAR COMPANY**
**NAMPA, IDAHO**

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*Section F*

# A NOVEL METHOD OF HANDLING FILTER AID

Filter aid handling prior to the 1988-89 Campaign at Nampa was labor intensive and operationally inefficient. Filter aid had always been introduced to the process by emptying multi-wall paper bags of the product into a tank of the liquor in which the perlite or diatomaceous earth was intended to be dispersed. A dusty environment, the use of excessive amounts of water to assist dispersion and disposal of the large number of paper bags proved to be among the many inefficiencies and potential health problems associated with the use of filter aid.

Other than large and expensive bulk handling facilities, 50-lb. bags of product seemed to be the only other option. Or was it? In 1987, the Nampa factory of Amalgamated Sugar Company inquired about semi-bulk packaging of filter aid. Both the Harborlite Corporation and Eagle-Picher, Inc. responded favorably to the queries.

But what about moving the product from the semi-bulk "totes" to the end use process? In the mid-1980's, several adhesive manufacturing companies learned that low density thickeners such "Cab-O-Sil" and carboxyl-methyl cellulose could be transported using inexpensive pneumatic conveying systems such as air diaphragm pumps normally employed to pump slurries or sludges with high solids content. The air-actuated diaphragm pumps worked quite well on low density (10-15 lbs./ft.$^3$) solids, but would they serve as an inexpensive conveyance mechanism for filter aid with densities up to 60 lbs./ft.$^3$ ?

Experiments followed which concluded that conventional filter aids such as perlite and diatomaceous earth could indeed be "pumped" and conveyed over several hundred feet by means of an air diaphragm pump -- provided the following conditions are met:

1. The filter aid in the storage bags is kept dry;
2. That 90 psi air is available to actuate the diaphragm pump and,
3. That the pump is equipped with a means to fluidize the particulate mass of solids on the suction side of the pump.

Our initial experiments employed the use of a 2" diameter Marlow air diaphragm pump with Buna 'N' diaphragms. That same type of pump is still in use four Campaigns later.

Two modifications to the pump were required before final success was attained:

1. Fluidizing air lines (1/4" NPT) were provided to the inlet side of pump and,
2. The 5/8" diameter shaft internally connecting the diaphragms was modified to 7/8" diameter.

(The latter modification was the only internal mechanical change necessary to provide the pump with capability to convey higher density powdered products.) Other than these simple modifications, the air-actuated diaphragm pump performed very well.

Racks to support 500# and 1,000# totes were fabricated from 2" steel box tubing for suspension of the semi-bulk bags of filter aid above the pump while being emptied. Both Eagle-Picher and Harborlite participated in the experiment by supplying tote bags of the different filter aids for the initial plant scale trails.

Because of the natural "bridging" nature of filter aid products, a "rocker-arm" device was added to the support rack to prod the bottom of the tote bag and provide a continuous flow of material to the intake of the pump. (A vibrator mounted to the support rack would provide the same function at lesser cost.)

A translucent vinyl plastic hose was initially used as the conduit through which the filter aid was pumped to its destination. The translucent vinyl proved to be useful for observing material flow or detecting the exact location of pluggage when that occurred. The vinyl hose has since been replaced with 2" diameter thin-wall PVC pipe. Long radius elbows of the same material are used where 90-degree turns are required.

Once a means of conveyance was proved to be successful, use rate of the filter aid and dust control problems could be addressed.

### 1. PRE-COAT APPLICATION

In the case of pre-coat application, two volumetric bins were provided -- one above the pre-coat slurry tank for the standard liquor filters and the other above the pre-coat slurry tank for the Industrial pressure leaf filters which provide filtration for the 69 Brix syrup to be stored and processed after completion of Campaign (i.e., "juice run"). Each bin was designed to contain the volume equivalent of 3 bags of diatomaceous earth -- an amount determined to be adequate for pre-coating a 750 $ft.^2$ filter.

The bins are filled from semi-bulk bags using the air diaphragm pump. Since no automatic means of detection has yet been provided to "sense" when the bins are full, a plastic window (4" x 4") with a small air jet behind it (to keep the window free of dust) is provided as a means of observing when each bin is full. The top of the bin is hinged and kept sealed with 1/4"-thick soft rubber gaskets to prevent the escape of dust. A sock filter is mounted on top of each bin to allow the escape of air during bin filling operations -- another dust control measure.

Once filled and ready to be used, the bin is emptied by means of a slide gate withdrawn manually to gravity feed the bin content into the slurry tank directly under it. A considerable reduction in the quantity of filter aid used was noted when the volumetric pre-coat bins were installed. The operator option of using more filter aid than required had been eliminated and standardization established.

All other equipment and application techniques for pre-coating the standard liquor and thick juice filters remained the same as before the changes in the filter aid handling system were implemented.

## 2. BODY FEED APPLICATION

The ability to convey filter aid pneumatically on a semi-bulk scale also provided the opportunity to equip the filtration system with "day bins" for the continuous body feed of either diatomaceous earth or perlite.

A single hopper with a three-outlet bottom was constructed to contain three full semi-bulk bags of filter aid. Each of the outlets was fabricated to interface with an Accurate feeder. Each of the three feeders provides continuous filter aid metering to first filtration standard liquor filters, second filtration standard liquor filters and to the pressure leaf, thick-juice-to-storage filtration processes.

The filter aid metered form the Accurate feeders falls 12-inches vertically into a small slurry plot agitated by the creation of a vortex in the center of the pot. The vessel overflows the non-homogeneous dispersion to the suction side of the pumps providing flow to the three respective filtration processes previously described. The pump impellers complete the filter aid dispersion in the liquid being pumped.

Filtration system operators have found it convenient to fill the day bin at the beginning of each shift. The body feed system requires no additional attention for the remainder of that shift.

In a similar fashion as used in the fabrication of the volumetric pre-coat bins, the body feed day bin is provided with three hinged access doors, gasketed to provide dust control. The day bin is also equipped with a sock filter for dust control during the bin filling operation.

Graphic descriptions of the introduction of filter aid, both pre-coat and body feed, into the filtration processes are schematically depicted in FIGURE I.

## 3. ADVANTAGES OF SEMI-BULK FILTER AID HANDLING

1. Reduction of labor required to handle 50-lb. bags of filter aid;
2. Elimination of potential back injury problems commensurate with bag handling operations;
3. Elimination of emptied multi-wall bag disposal;
4. The semi-bulk tote bags are returnable. Hence, some packaging cost savings are realized by the vendor and passed on to the factory. (Each tote bag can be recycled 4 or 5 times before it is removed from further service.);
5. Dust reduction using semi-bulk handling is significant if the bins are well gasketed and there are no leaks in the supply lines from the air diaphragm pump;

finally,

6. A significant savings in filter aid consumption is realized when the semi-bulk handling system is coupled with proper metering apparatus. The Nampa factory reduced its filter aid consumption ***from 0.794 lbs./ton of beets*** during the 1986-87 Campaign ***to 0.262 lbs./ton of beets*** during the 1988-89 Campaign due to the implementation of semi-bulk filter aid handling and the use of volumetric feeders. (**FIGURE II**)

## 4. OTHER APPLICATIONS

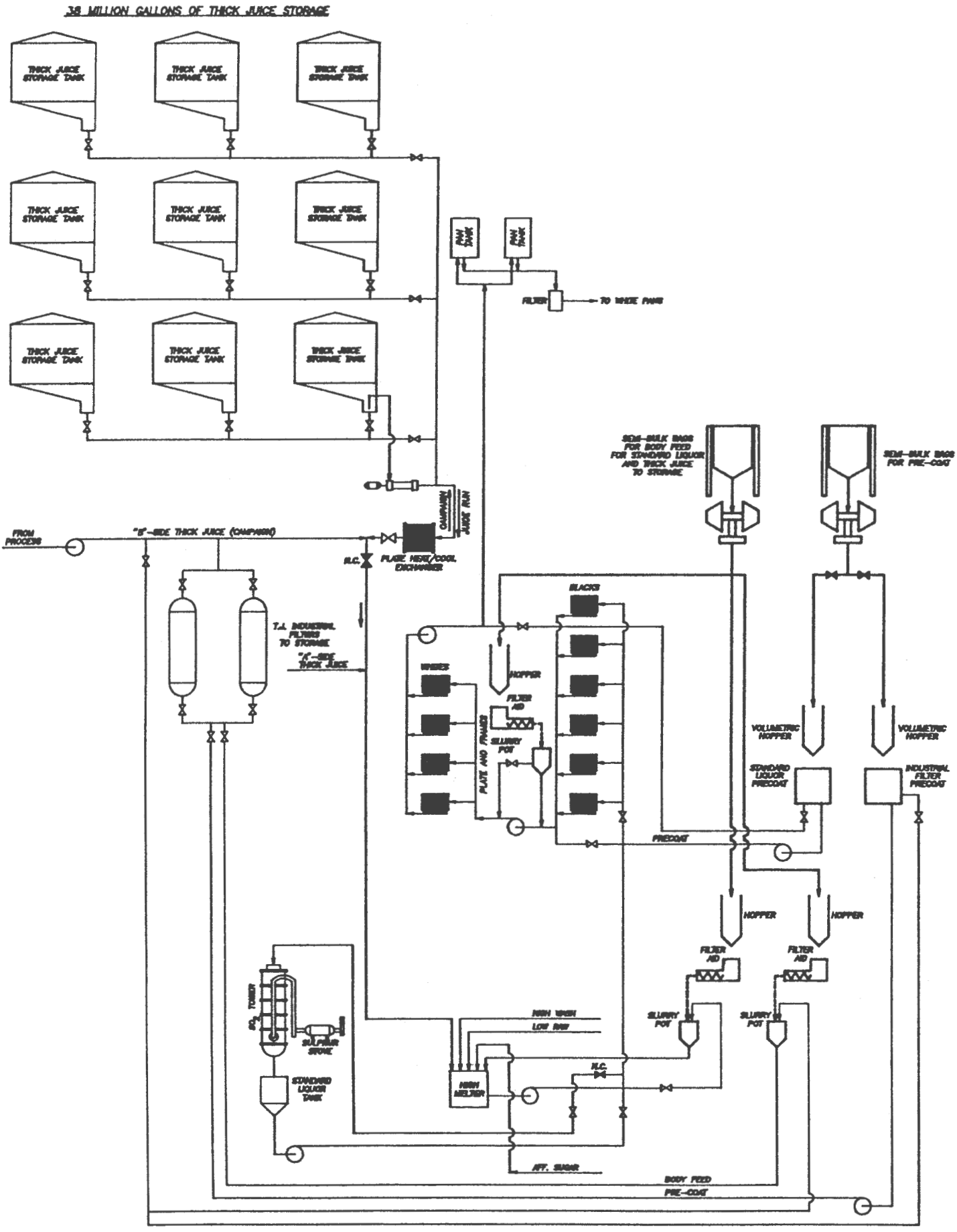
In addition to pumping the filter aid with an air diaphragm pump, the Nampa factory currently pumps corn starch vertically 30 feet to a feeder bin in the powdered sugar manufacturing facility. By doing so, the use of a mechanical elevator to convey a

fine organic powder has been eliminated, thereby greatly reducing the potential of a dust explosion. (Note: The conduit through which the powdered starch is pumped is 2" diameter, spiral-wound, reinforced vinyl hose and is grounded to prevent static electrical discharge.)

At this time, Amalgamated Sugar Co. has not yet found a vendor to supply powdered starch in semi-bulk tote bags, but we are continuing our attempt to persuade current vendors to provide this type of packing.

It would seem that there may be many other applications yet undiscovered for the use of the air diaphragm pump as a means of primary conveyance. It's only limitations seem to be materials having a bulk density in excess of 60 lbs./ft.$^3$ and/or particle sizes which are too large (or too heavy) to pass through the diaphragm without damaging it. (NOTE: Because of its bulk density, the air diaphragm will not pump sugar crystals.)

The search should continue for other applications of this simple and inexpensive device. Initial capital cost is low, maintenance is very easy and replacement parts are very inexpensive.


38 MILLION GALLONS OF THICK JUICE STORAGE
THICK JUICE STORAGE TANK
PAN TANK
FILTER
TO WHITE PANS
SEMI-BULK BAGS FOR BODY FEED FOR STANDARD LIQUOR AND THICK JUICE TO STORAGE
SEMI-BULK BAGS FOR PRE-COAT
FROM PROCESS
"B"-SIDE THICK JUICE (CAMPAIGN)
CAMPAIGN JUICE RUN
H.C.
PLATE HEAT/COOL EXCHANGER
T.J. INDUSTRIAL FILTERS TO STORAGE
"A"-SIDE THICK JUICE
BLACKS
WHITES
HOPPER
FILTER AID
SLURRY POT
PLATE AND FRAMES
VOLUMETRIC HOPPER
STANDARD LIQUOR PRECOAT
INDUSTRIAL FILTER PRECOAT
PRECOAT
HOPPER
FILTER AID
SLURRY POT
TOWER
SULPHUR STOVE
STANDARD LIQUOR TANK
HIGH MELTER
HIGH MELT
LOW MELT
H.C.
AFT. SUGAR
BODY FEED
PRE-COAT

446 FIGURE I

# FILTER AID CONSUMPTION

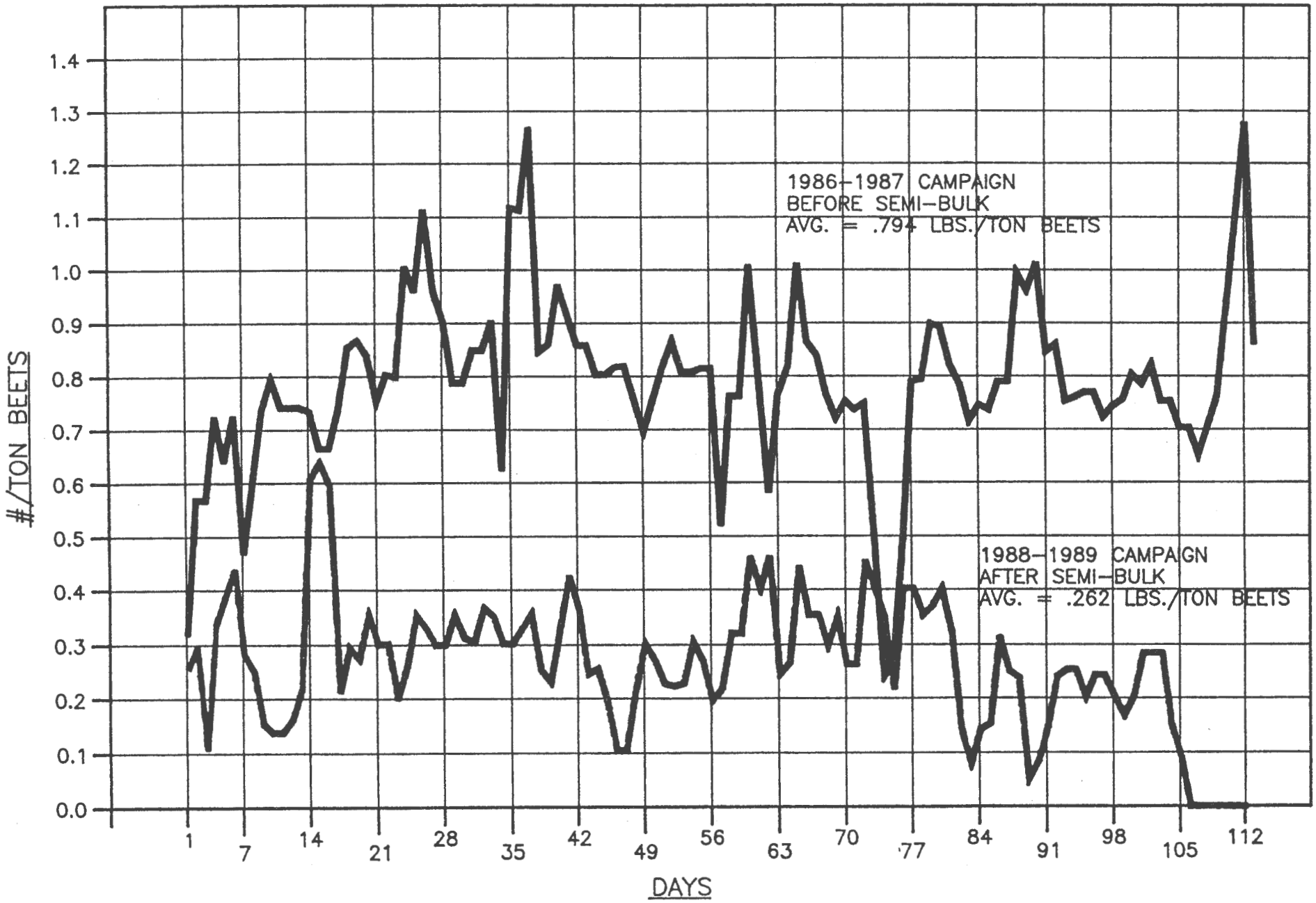



FIGURE I.