# THE DISTRIBUTION AND ANALYSIS OF ALL THE STREAMS ON THE KANSAS STATE UNIVERSITY WHEAT FLOUR MILL

by

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# INTRODUCTION

The purpose of this study was to investigate quantitatively the distributions of stock of several different wheats to and from each milling machine on a production scale flour mill. The quantitative part of the study measured the flow rate of stock at every point in the mill. Some factors normally associated with the qualitative evaluation of flour and the milling process were necessary to complement the quantitative study. The qualitative portion of such a study must consider weight and such quality factors as ash and protein.

Farrell and Ward (10) pointed out the lack of such information and also noted its uses "1) to improve quality or yields or both; 2) to select or adapt sifter screen openings better suited to the machines that process one or more particular streams; 3) to design the flow diagram for new flour mills; 4) to predict in pounds per minute how much each pneumatic lift must carry in the design of pneumatic lifts." Hence the importance of the quantitative aspect of this study.

In the production of white flour for baked products the ash content of the flour has long been used as one of several standards of quality. Ash can be defined as mainly inorganic matter which remains after a sample has been incinerated at 550°C. for 10 hours. The ash is known to be more concentrated in the outer covering or bran and germ of the wheat kernel than in the starchy endosperm. Since the major concern in the milling of wheat into white flour is the clean separation of the low ash endosperm from the high ash bran and germ, the efficiency of the separation can be judged approximately from the ash content of the flour produced. In laying out the flow of a new mill, or to improve the flow of an existing mill, it is essential to be able to estimate the probable ash in each stream to avoid contamination of low ash stock with stock with much higher ash. Of course the particle size of the stock and the availability of equipment must be taken into account when originating or altering the flow of a mill.

This study was conducted on the Kansas State University Pilot Flour Mill. The capacity of the mill is 200 weights per 24 hours. The mill uses pneumatic conveying and gravity for the movement of stock to the various systems. The air temperature and humidity in the mill rooms were automatically controlled. Flow sheets of the mill as it was used for the wheats concerned and a list of the production equipment in the mill are presented in the section Methods and Materials.

The wheats milled consisted of two samples of hard red spring wheat, one soft red winter wheat, one soft white wheat (Gaines), and five hard red winter wheats. Each of these wheats are more fully described in the section Methods and Materials. Farrell and Ward (10) conducted a similar study on the same flour mill using two hard red winter wheats. Some of their data for this class of wheat was used in this study.

## SURVEY OF LITERATURE

A study of practical flour milling must start with a sound knowledge of the structure of the wheat kernel. Bradbury et al. (4) in their studies of the structure of the wheat kernel divided the berry into five general parts; the pericarp, seedcoat and pigment strand, nucellar epidermis and nucellar projection, endosperm and germ. King (21) and Bates (2) showed some very clear pictures of these structures. Scott and Maclay (36) described the relation of the parts of the bran with the endosperm.

The pericarp, which represents four to six percent of the total (4) weight of the kernel, is the outermost covering of the kernel and can be divided into six distinguishable layers. Just inside the pericarp and firmly bound to it is the seed coat which encompasses the embryo and endosperm and is joined at the pigment strand in the crease. The pigment strand and the nucellar projection lie along the crease with the latter being the joining point of the nucellar epidermis. The nucellar epidermis is a single layer of cells tightly compressed between the seed coat and the endosperm and strongly united to both.

The outermost layer of the endosperm is composed of thick walled cells which contain no gluten or starch. These cells are the aleurone layer of the endosperm. Bran, as the term is used in flour milling, includes the aleurone layer and all that is outside of it (24). Thus there is no distinct cleavage line between the remaining endosperm, the aleurone and the bran. The remaining endosperm without the aleurone is often referred to as starchy endosperm, and is made up of cells containing starch granules embedded in proteinaceous material. The endosperm usually accounts for approximately 80 to 86 percent of the weight of the kernel.

The germ is the living portion of the seed, containing the embryo and its parts. It is located in one end of the oval shaped berry. The germ is covered on the outside by the seed coat and is not tightly bound in the kernel (4). By weight the germ is two to three percent of the kernel.

MacMasters et al. (24) gave a quantitative relation of the milled fractions of the wheat kernel as follows: bran 14 to 16 percent, starchy endosperm 81 to 84 percent, germ 2.5 to 3.6 percent by weight. Though not a distinct mill fraction, aleurone was listed as 6.7 to 7.0 percent of the kernel by weight (40 to 50 percent of the bran). The ash of each fraction was also listed as a percent of ash in the fraction and as a percent of the ash in the whole kernel.

| Ash in fraction | | Percent of total ash in kernel |
|---|---|---|
| bran | 4.8 to 6.7% | 68. |
| endosperm | .26 to .55% | 20. |
| germ | 3.65 to 9.47% | 12. |

The ash in the aleurone layer was said by MacMasters et al, (24) to be 14.37 to 17.2 percent. They then listed this as about 61 percent of the ash in the kernel. From this it becomes clear that the ash of the wheat kernel is concentrated in the aleurone layer. This leads to the statement (24) that color grade value and ash content of flour are not significantly related since aleurone particles will greatly alter the ash of the flour but will not appreciably affect the color grade value.

Morris et al (29), working with one variety each of three classes of wheat (hard red winter, hard red spring, and soft red winter), showed by separating the endosperm from five areas that the ash increased going from the center to the periphery of the endosperm. Hinton (14), working separately, found similar distributions of ash in the endosperm. Morris et al (27) found the bran to contain 13 to 18 times as great a percent of ash by weight as the entire starchy endosperm.

The difference in ash content between endosperm and bran makes the ash content of the flour a sensitive indicator of the efficiency of the separation of low ash flour from the high ash bran. When first discovered, ash differences were used to guide milling process control. Soon flour ash was used in pricing flour and its importance got out of proportion to its value in estimating flour baking quality. It has since been shown (19, 30) that baking quality of flour is not necessarily indicated by its ash content. Ash is still, however, a valuble tool to the miller in his own mill in measuring the efficiency of the separation of the endosperm from the bran.

Shuey (37) gave as "yardsticks for measuring milling values of wheats, and their milling characteristics" flour yield, both patent and total flour, the milling rate of the wheat, the temper required, both as to time and amount, and the ash of the flour. The factors influencing flour ash were divided into three main classes, environmental influences, hereditary influences, and physical treatment. The first two of these can be controlled by the miller only by selective purchasing. The third however can essentially be controlled by the miller. It was subdivided into handling and storage of wheat, cleaning, tempering or conditioning, and milling of wheat. Robbins (31) gave a somewhat similar set of factors effecting ash in flour.

A flour mill is a continuous integration of many operations to obtain a common goal, the production of the largest possible quantity of white flour suitable to the consumer's needs, from the smallest possible quantity of wheat. Bouskill (3) divided the actual milling process into five operations, breaking, grading, purifying, reducing, and dressing or bolting the endosperm. The conditioning and treatment of the wheat prior to milling must also be taken into account when considering the overall performance of a flour mill on a given wheat. Each of these is a distinctly different operation but each depends upon the previous operations. Each operation will affect the subsequent operations, but to a diminishing degree as available endosperm becomes less toward the end of the milling manufacturing process. Each of the operations involved in the production of white flour is an important factor in the overall process but none can individually be responsible for the success of the entire process. On the other hand however, any one operation can cause the overall process to fall short of its goal. Each operation can be evaluated separately from the rest of the mill but the true story is not told until they are evaluated as an integrated process.

One method of evaluating the overall process is by plotting the cumulative ash curve of all the flour streams in the mill. This is a valuable tool in evaluating the performance of the mill and the milling value of the wheat (10, 44). Wismar (44) gave some of the background and development of the use of cumulative ash data. This method derives its value from the fact that it takes into account both ash and quantity of all the flour streams at once.

Miller (26) pointed out that by shifting the bulk of the flour production toward the tail of the mill it would be possible to decrease the ash content of every stream in the mill and still have increased straight grade ash. Such a situation would be quite difficult to correctly analyze by investigating only the qualitative data of the individual flour streams. The shape of the cumulative ash curve would make this clear at a glance since it would rise more uniformly along its entire length.

Rozsa (32, 33, 34) presented a short history of the development of the use of granulation curves and their use in controlling and balancing a mill. He stated that once it is determined that the mill is in balance and operating properly the granulation curve should remain constant from day to day. Rozsa (33) stated further that the curves should be used to indicate changes in roll corrugations (worn corrugations), roll settings, sifter efficiency, wheat temper, general milling condition of the wheat, and hence the balance of the mill.

Rozsa (32) presented the flow sheet of the 1000 barrel hard winter wheat flour mill from which the data he used were taken. The data were first published by Hodges (15, 16, 17). Hodges gave the weight, in pounds, of every stream in the mill. Each stream was also given as a percent of the section from which it originated. Rozsa (32) gave a tabled analysis of the disposition of the milling equipment throughout the mill as well as the loading of the equipment.

Rozsa (34) used the data previously presented by himself (32) "to demonstrate how the application of the 'granulation curve' may be useful in reviewing the operation of a flour mill." In so doing he presented the granulation curves of all the breaks and nearly all of the reductions.

Farrell and Ward (10) gave the distribution of stock throughout the Kansas State University Pilot Flour Mill. The weight of each stream was accompanied by the ash and protein of the stream. These analyses help to give meaning to the flow of the mill since not only particle size but also the ash of the stock is considered when a flow is developed. In the same article they demonstrated one use of the data by giving an example of how granulation curves can be used in developing a new flow sheet or improving an existing one. The authors pointed out the importance of predicting the flow rates of the various streams in a mill when designing pneumatic systems.

Several other mills have been described in the literature by the use of stream weights and analyses but they are incomplete in their analyses and stream weights. Scott (35) presented a flow sheet of an English mill (50 sacks of flour each 280 pounds per hour) which produced 3360 hundred weights per 24 hours. The flow sheet includes the flow rates of most of the streams but no description of the wheat was given and no analyses were included.

Scott (35) discussed the comparative granulation of stock ground from hard and soft wheats. In so doing it was convenient to consider the initial breaks and the tailend breaks separately. Scott (35) stated that "At normal milling moisture values, the release with equal roll settings is usually higher on the first and second break rolls for soft wheats than for hard." Granulation curves were presented to verify this break release difference between No. 3 Manitoba (hard) and Russian (soft) wheat. "On the later break rolls the release from soft weak grain is usually low because of the relatively high initial release and because the skin is tough and remains in large fragments to which the endosperm adhers tenaciously. For the reverse reasons the release from strong dry brittle-skinned wheats are comparatively high on the final breaks."

Miller (26) gave a comprehensive verbal description of the stock throughout a flour mill of undisclosed capacity. Diagrams of each sifter and purifier section gave the flow rate and analyses of most of the streams.

The wheat was described as hard red winter but the analyses were not given for all the streams.

Jurkey (18) studied sifter performance in a hard wheat flour mill which milled 5557 pounds per hour of hard wheat. The weights of the streams leaving each sifter in the mill were given in pounds per hour and as a percent of the wheat sent to first break. Since the study was concerned only with the physical separations made by the sifters no chemical analyses were made.

Gehle (13) described a method of designing pneumatic conveying systems by expressing the weight of each stream in the mill as a percent of stock to first break. Using this method Gehle theorized a method of reducing necessary conveying capacity and hence power consumption.

## METHODS AND MATERIALS

Nine samples of wheat from four classes were milled in this study. Five of the samples were hard red winter wheats, two were hard red spring wheats, one was a soft red winter, and one was a soft white wheat. Each sample came from an area of the United States in which its class of wheat is commonly grown (Table 1). Hereafter each sample will be referred to by the abbreviated names which appear in parenthesis in Table 1.

Of the two hard red spring wheats, one was relatively high in protein content and the other was low in protein. For this reason they have been referred to as hard red spring low protein and hard red spring high protein throughout this study. The soft white wheat was the well known Gaines variety and so was referred to as Gaines for this work. The hard red winter wheats were made up of one low protein wheat, one high protein wheat,

Table 1. Description of wheats.

| Wheat | Description of origin |
|---|---|
| Hard red winter low protein (HRW-L) | Blackwell, Oklahoma, dominant variety in the Blackwell area was Triumph. |
| Hard red winter high protein (HRW-H) | Burdett, Kansas, probably a mixture of Early Triumph and Bison. |
| Hard red winter (HRW-1) | Blended to 11.5% protein from several bins of wheat grown near Manhattan, Kansas, in 1964. |
| Hard red winter (HRW-2) | Blended to 11.2% protein from several bins of wheat grown near Manhattan, Kansas, in 1965. |
| Hard red winter (HRW-3) | Blended to 11.9% protein from wheats from several locations all in Kansas. |
| Hard red spring low protein (HRS-L) | Grown near Choteau, Montana, the predominant varieties in the Choteau area were Ceres and Thatcher. |
| Hard red spring high protein (HRS-H) | Grown near Valley City, North Dakota, variety was believed to be a mixture of Pembina and Justin. |
| Soft white (Gaines) | Grown at Pullman, Washington, variety was Gaines which was the leader in the Idaho, Oregon, and Washington white wheat area. |
| Soft red winter (SRW) | Grown near Winchester, Indiana, where the variety Manor was rapidly becoming favored over Knox. |

and three samples which were each blended to near 11.5 percent protein.

Some of the quality factors commonly used to evaluate wheats for milling value appear in Table 2.

Data from the milling of hard red winter wheats on the existing Kansas State University Pilot Flour Mill were reported by Farrell and Ward (10).

Table 2. Analyses of wheats.

| | Name of wheat mix | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | HRW-L | HRW-H | HRW-1 | HRW-2 | HRW-3 | HRS-L | HRS-H | Gaines | CWJ |
| Protein (%)* (Nx5.7) | 10.7 | 13.3 | 11.2 | 11.5 | 11.9 | 11.1 | 13.8 | 9.2 | 11.8 |
| Ash (%)* | 1.69 | 1.66 | 1.50 | 1.44 | 1.55 | 1.59 | 1.65 | 1.20 | 1.61 |
| Moisture (%) | 13.5 | 12.1 | 14.0 | 10.4 | 11.2 | 14.0 | 11.2 | 13.0 | 14.7 |
| Test weight (lbs/bu) | 63.0 | 62.6 | 56.9 | 61.2 | 57.4 | 61.4 | 59.6 | 64.3 | 61.7 |
| Pearling value (%) | 59.7 | 62.2 | 63.5 | 69.2 | 67.5 | 65.5 | 60.7 | 60.5 | 55.0 |
| 1000 kernel wt. (gm) | 32.5 | 29.4 | 31.1 | 26.4 | 23.1 | 20.9 | 22.0 | 33.2 | 33.4 |
| Wheat size | | | | | | | | | |
| Over 7W (%) | 78.0 | 57.0 | 76.0 | 45.0 | 65.5 | 72.0 | 41.5 | 68.0 | 89.5 |
| Over 9W (%) | 21.5 | 42.0 | 23.5 | 53.0 | 34.0 | 27.0 | 57.5 | 31.5 | 14.5 |
| Over12W (%) | 0.5 | 1.0 | 0.5 | 1.0 | 0.5 | 1.0 | 1.0 | 0.5 | 0.0 |

*14% moisture basis.

These data were used in this study as representative of the performance of the Pilot Flour Mill on Hard Red Winter wheat. This wheat is referred to in this paper as HRW.

A list of abbreviations used in this report are shown in Table 3.

Table 3. Abbreviations used.

| Abbreviation | Definition |
|---|---|
| Bk. red. | 1,2,3, break redust |
| 1,2,3 Red | 1,2,3 break redust |
| C. Siz. | coarse sizings |
| F. Siz. | fine sizings |
| T. Fl. | top flour (from upper series of flour cloths) |
| B. Fl. | bottom flour (from lower series of flour cloths) |
| 1 M | first middlings |
| 2 Q | second quality |
| 1T | first tailings |
| Ssc. | suction section |
| B.D. | bran duster |
| S.D. | shorts duster |
| B.& S.D. | bran and shorts duster section |
| P-1 | purifier one |
| tt (TT) | Tuf-Tex sieve clothing |
| gg (GG) | grit gauze (silk) sieve clothing |
| XX | Swiss silk sieve clothing |
| + (followed by sieve size) | overs of the indicated sieve |
| - (followed by sieve size) | thrus of the indicated sieve |
| HRS | hard red spring wheat |
| HRW | hard red winter wheat |
| SRW | soft red winter wheat |
| 3 Bk. F | third break fine |
| 3 Bk. C | third break coarse |
| 4 Bk. F | fourth break fine |
| 4 Bk. C | fourth break coarse |
| cwt | hundred weight |
| T.P. | total products |

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## Cleaning

Prior to conditioning and subsequent milling, each of the wheats was cleaned using the cleaning house facilities of the Kansas State University Pilot Flour Mill. The wheat was conveyed through the entire cleaning system by gravity flow and pneumatic conveying systems. An automatic dump scale followed by a constant flow gravity feeder maintained an even 60 bushel per hour flow of wheat to the cleaning equipment. The actual cleaning equipment consisted of a permanent magnet, pneumatic lift aspirator, milling separator, dry stoner and gravity table, disc separator (oats), disc separator (small seeds), impactor-scourer-aspirator, and a duo-aspirator. The cleaned wheat flowed into a holding bin which was used to insure an adequate supply of wheat for a constant flow to the tempering system. The wheat was tempered immediately after being cleaned.

## Tempering

The tempering equipment consisted of the holding bin mentioned above, a scale feeder, a pneumatic lift, and 43 feet of 6-in. standard screw conveyor turning 43 revolutions per minute used to mix the water with the wheat and to convey the wet wheat to the tempering bins. The tempering bins consisted of eight bins each having a capacity of 25 bushels.

All the samples milled for these tests were tempered using a cold conditioning procedure, using different final moisture levels for the hard and soft wheats. The scale feeder was adjusted to deliver a constant flow of 60 bushels per hour to the conditioner. The tempering water was added in one metered stream as the wheat entered the conditioner. The water and the wheat were both at room temperature.

The moisture of the wheat flowing to the scale feeder was determined using a Tag Heppenstal moisture tester (7). Using this moisture as the untempered wheat moisture, the necessary amount of water for tempering to the desired moisture level was calculated using the following formula:

$$\frac{100 - M_1}{100 - M_2} \times R_1 - R_1 = X$$

$M_1$ = percent moisture in the untempered wheat
$M_2$ = percent moisture desired in tempered wheat
$R_1$ = flow rate of untempered wheat
$X$ = flow rate of water to be added

The tempered wheat was held in the tempering bins for 20 hours prior to milling.

Upon milling, the tempered wheat was drawn from all eight tempering bins simultaneously. This was done to insure that a uniform blend of tempered wheat was sent to the mill.

## The Wheat to Pre-break

The blended and tempered wheat was sent through a brush machine as it came from the tempering bins. From the brush machine the wheat was pneumatically conveyed to an automatic dump scale on the top floor of the flour mill. The dump scale was set to release 60 pounds per dump. A counter attached to the release mechanism recorded the number of dumps made by the scale. The time cycle between dumps was set on an electric timer to deliver wheat at the rate desired for the mill.

The belt feeder continuously regulated the flow of wheat over the belt and automatically corrected its feed gate to deliver a constant flow at the rate of wheat desired to go to the mill.

The feed rate which the feeder was to maintain was set according to the capacity desired on the mill for the particular class of wheat being milled. Once set, a counter recorded the quantity of wheat delivered to the mill. Thus a double check of the total quantity of wheat sent to the mill and the rate at which it was milled was possible.

To facilitate optimum performance of the pilot flour mill on each of the various classes of wheats the moisture of the tempered wheat and the rate at which it was milled were varied. Several warm-up or trial millings were performed with both of the soft wheats and the two hard red spring wheats.

From these warm-up runs it was determined that the hard red spring wheats could be milled under the same conditions normally used in the pilot mill for hard red winter wheats. All of the hard wheats milled in this study were milled at 16.0 percent moisture and were delivered to the pre-break rolls at 18 bushels per hour.

It was found that both the soft wheats could be milled well at 15.0 percent moisture. The SRW wheat was delivered to pre-break at 16.0 bushels per hour and the Gaines was milled at 14.5 bushels per hour.

The Pilot Flour Mill

The Kansas State University Pilot Flour Mill has a production capacity of 200 weights of flour per 24 hours on hard wheats. Although this is somewhat small in comparison to most present commercial flour mills, special care was taken in the use and allocation of the available equipment so that the pilot flour mill could simulate most performance by ordinary commercial plants. The ash of the straight grade flour from the pilot mill is usually lower at a corresponding yield than is common in most commercial plants. Otherwise flour production and its by-products are most often accepted as analogous to those from larger mills.

Conveying of stock through the mill is entirely by pneumatics and gravity to the milling equipment distributed over four and one half floors. The temperature and relative humidity within the milling rooms was controlled automatically. The temperature was maintained at 80 ± 5 degrees Fahrenheit and the relative humidity was held at approximately 70 percent.

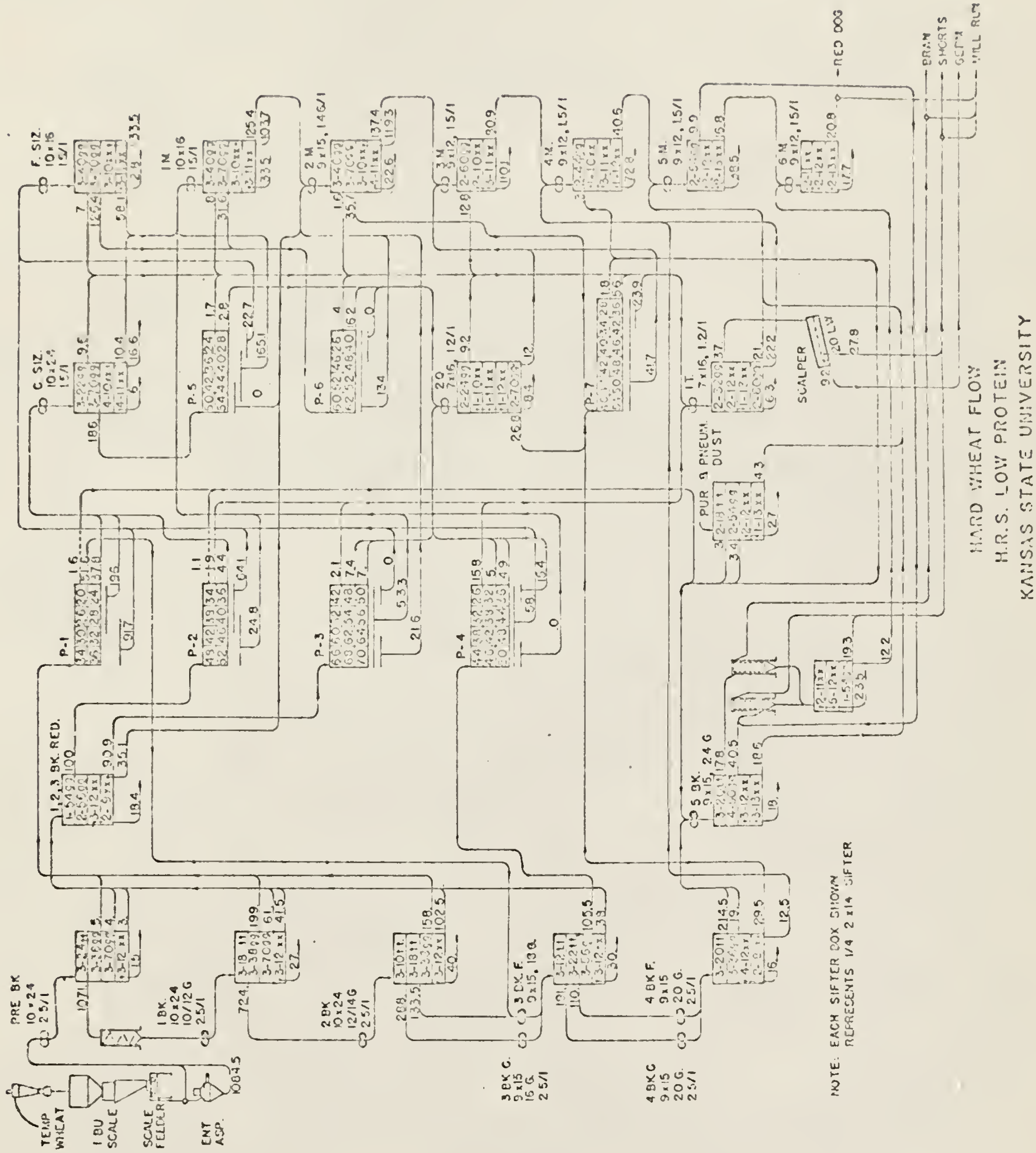
The flow diagrams of the pilot mill as it appeared when each sample was milled appear as follows: HRS-L, Plate I; HRS-H, Plate II; Gaines, Plate III; SRW, Plate IV; HRW, Plate V. The flow rates in pounds per hour stream in the mill appear near the represented stream on the flow sheet for each of the wheats.

Prior to this study the pilot mill was flowed solely for milling hard wheats. While attempting to keep the changes in the flow to a minimum, it was necessary to make certain changes in sifter clothing. These changes were determined from a series of warmup millings on the hard red spring and soft wheats. The changes are shown in Fig. 1.

## EXPLANATION OF PLATE I

The flow sheet of the pilot flour mill as it was when the hard red spring low protein wheat was milled. The flow rate of each stream is shown in pounds per hour.

PLATE I

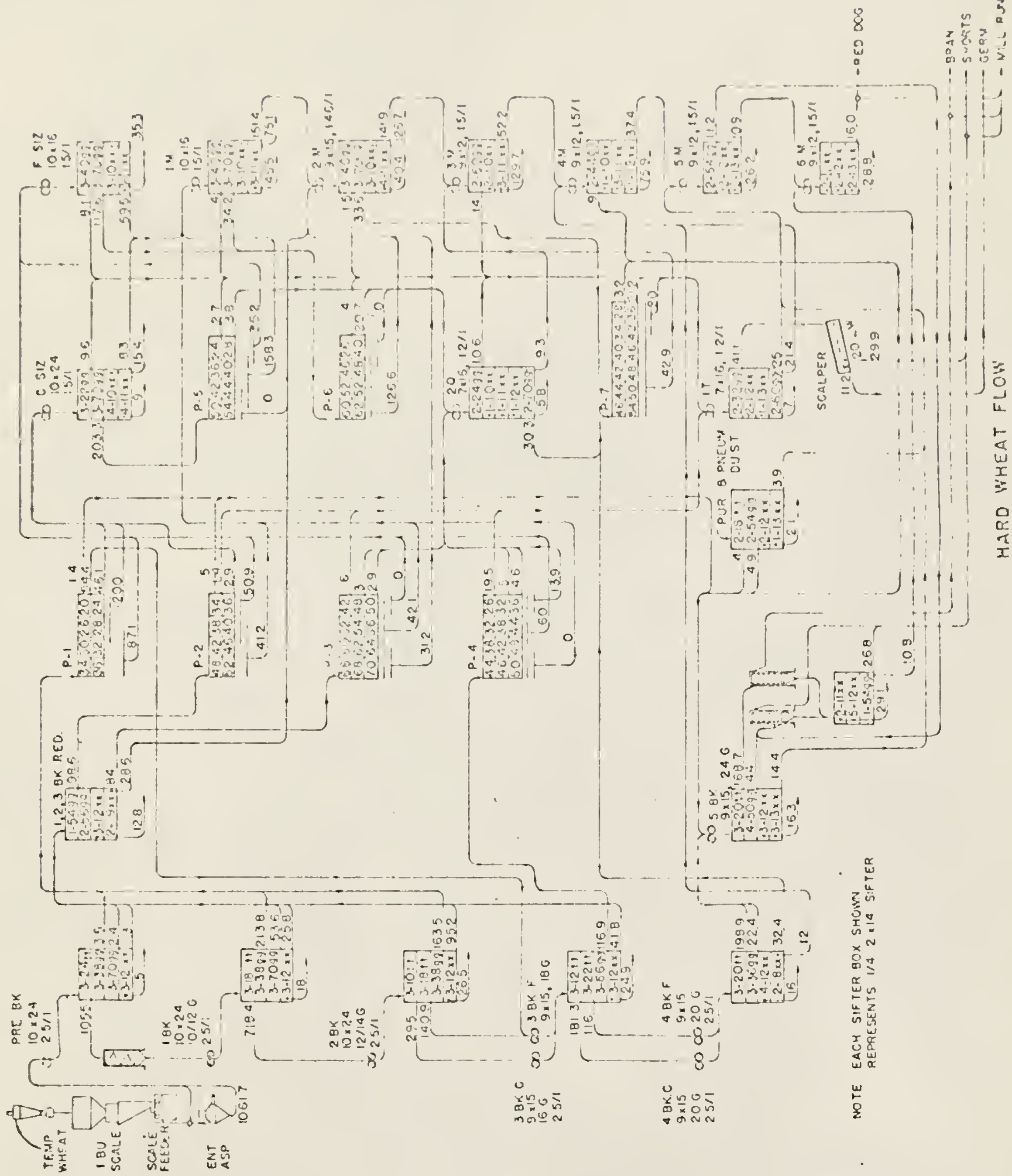


HARD WHEAT FLOW
H.R.S. LOW PROTEIN
KANSAS STATE UNIVERSITY
PILOT FLOUR MILL
NOTE: EACH SIFTER BOX SHOWN REPRESENTS 1/4 2 x 14 SIFTER

## EXPLANATION OF PLATE II

The flow sheet of the pilot flour mill as it was when the hard red spring high protein wheat was milled. The flow rate of each stream is shown in pounds per hour.

# PLATE II



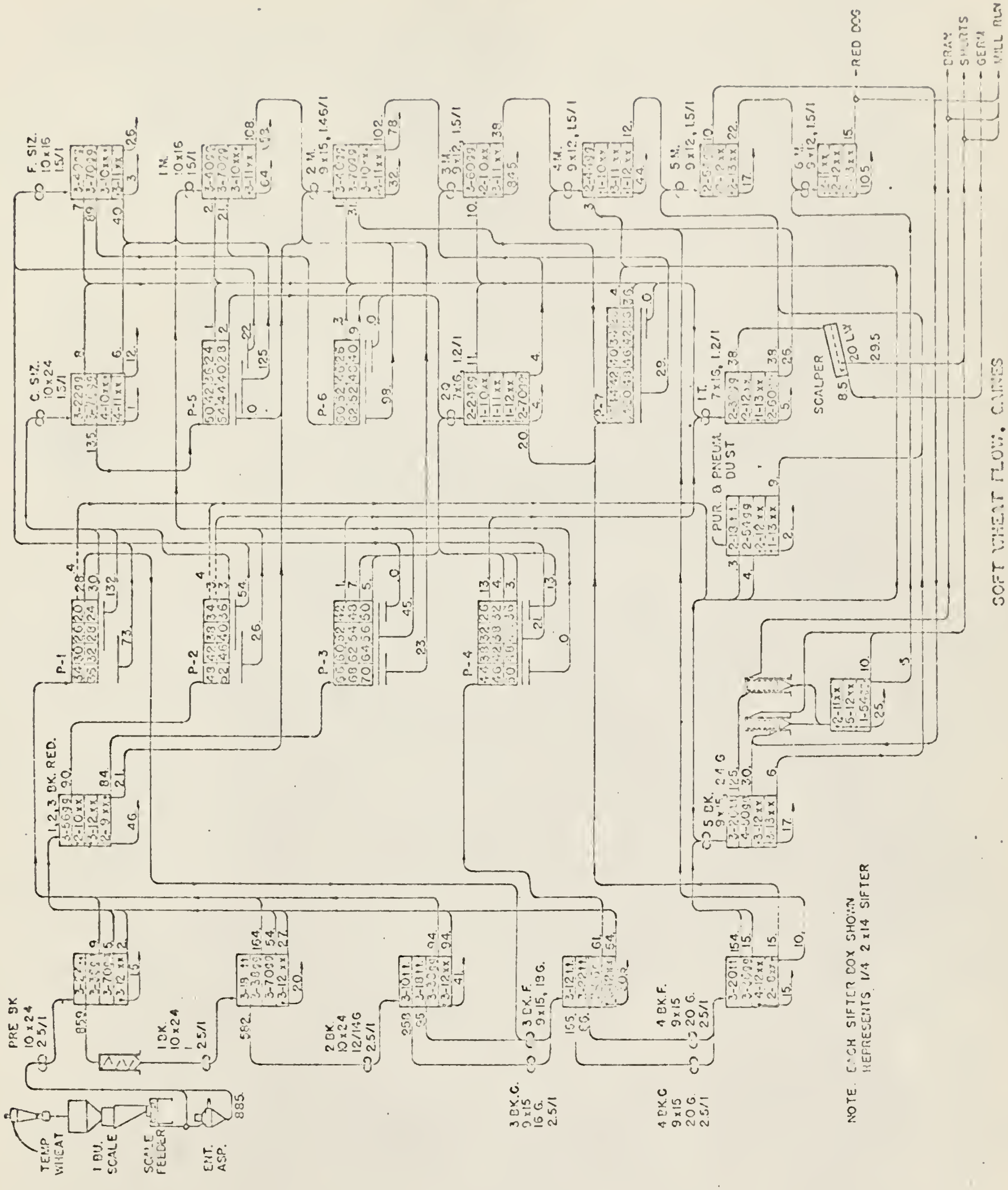
NOTE EACH SIFTER BOX SHOWN REPRESENTS 1/4 2x14 SIFTER

HARD WHEAT FLOW
H.R.S. HIGH PROTEIN
KANSAS STATE UNIVERSITY
PILOT FLOUR MILL

## EXPLANATION OF PLATE III

The flow sheet of the pilot flour mill as it was when the western white wheat was milled. The flow rate of each stream is shown in pounds per hour.

PLATE III




SOFT WHEAT FLOW, CAMMS

200 CWT FLOUR MILL

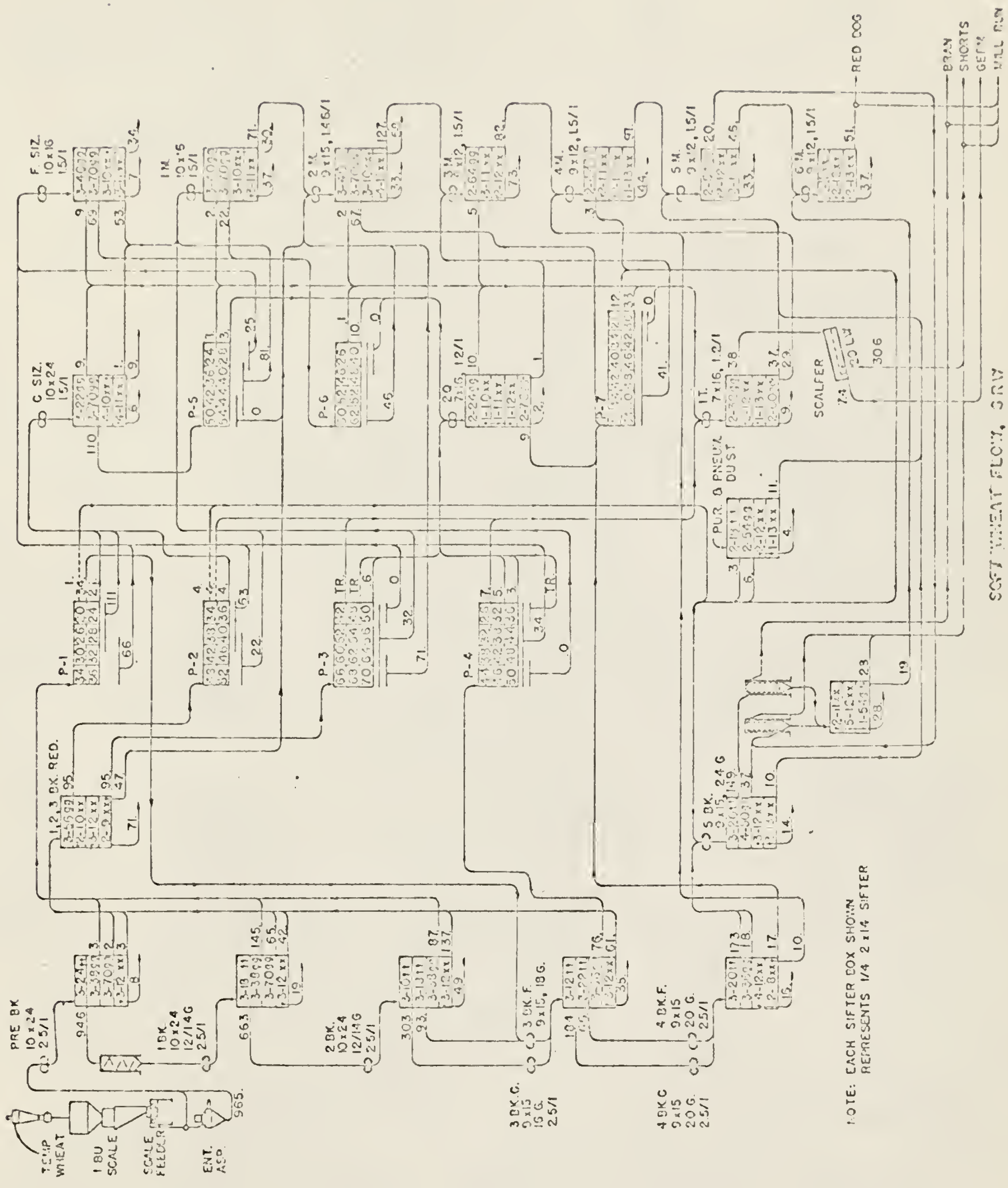
KANSAS STATE UNIVERSITY

NOV. 12, 1965

## EXPLANATION OF PLATE IV

The flow sheet of the pilot flour mill as it was when the soft red winter wheat was milled. The flow rate of each stream is shown in pounds per hour.

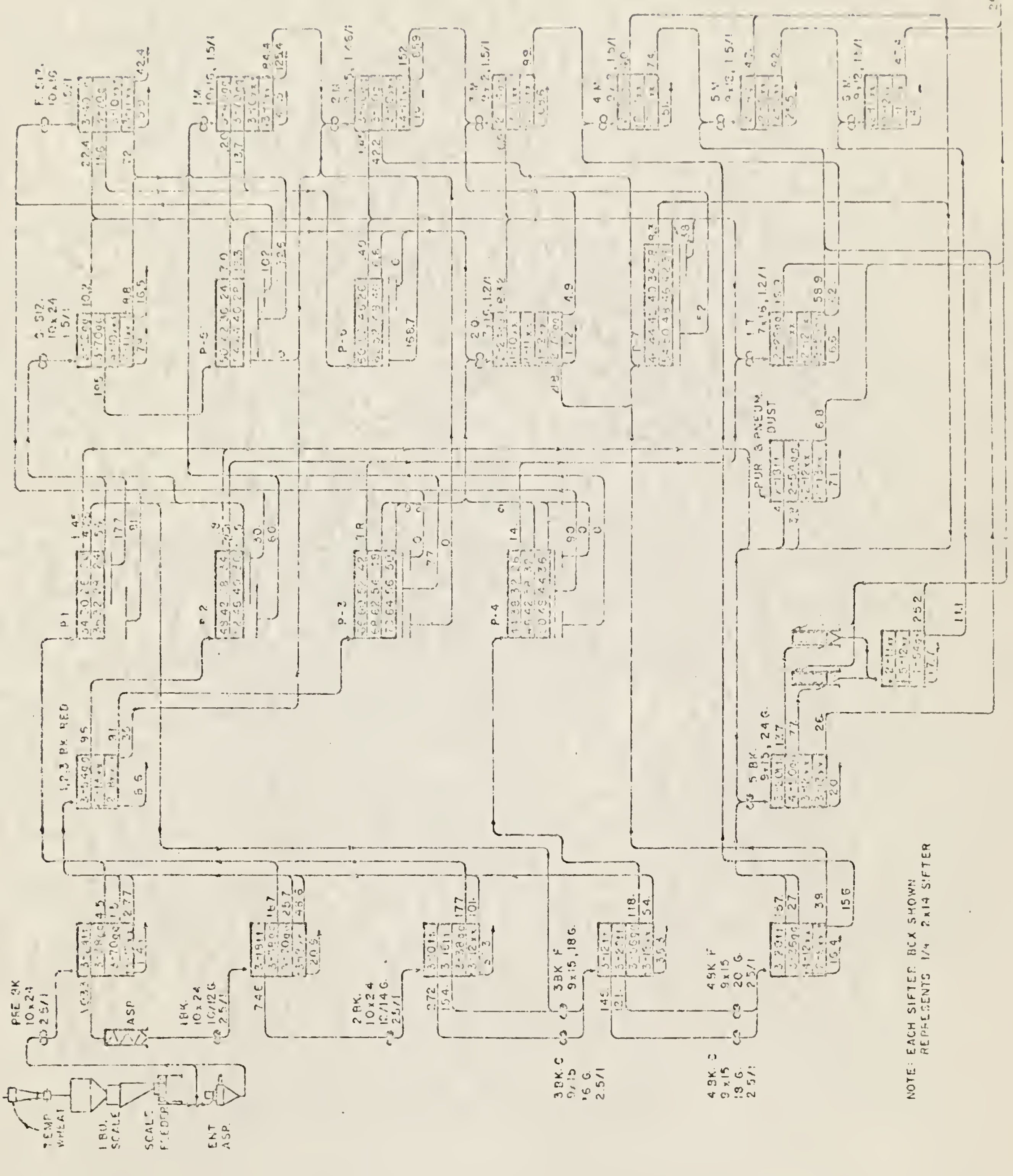
PLATE IV


SOFT WHEAT FLOW, SRW
200 CWT FLOUR MILL
KANSAS STATE UNIVERSITY
NOTE: EACH SIFTER BOX SHOWN
REPRESENTS 1/4 2 x 14 SIFTER
RED DOG
BRAN
SHORTS
GERM
MILL RUN
SCALFER
PRE BK.
1 BK.
2 BK.
3 BK. F.
4 BK. F.
5 BK.
1, 2, 3 BK. RED.
P-1
P-2
P-3
P-4
P-5
P-6
P-7
C SIZ.
F. SIZ.
1 M.
2 M.
3 M.
4 M.
5 M.
6 M.
1 T.
2 Q.
PUR. & PNEUM. DUST
1 BU SCALE
SCALE FEEDER
ENT. ASP.

## EXPLANATION OF PLATE V

The flow sheet of the pilot flour mill as it was when hard red winter wheats were milled in a previous study. The flow rate of each stream is shown in pounds per hour.

PLATE V


TEMP WHEAT
1 BU. SCALE
SCALE FEEDER
ENT ASP.
PRE BK 10x24 2.5/1
ASP
1 BK. 10x24 10/12 G. 2.5/1
2 BK. 10x24 12/14 G. 2.5/1
3 BK. C 9x15 16 G. 2.5/1
3 BK F 9x15, 18 G.
4 BK. C 9x15 18 G. 2.5/1
4 BK F 9x15 20 G. 2.5/1
5 BK. 9x15, 24 G.
1,2,3 BK RED
P 1
P 2
P-3
P-4
P-5
P-6
P-7
C. SIZ. 10x24 1.5/1
F. SIZ. 10x16 1.5/1
1 M 10x16, 1.5/1
2 M
3 M
4 M
5 M
6 M
2 Q
1 T 7x15, 1.2/1
PUR & PNEUM. DUST
NOTE: EACH SIFTER BOX SHOWN REPRESENTS 1/4 2x14 SIFTER

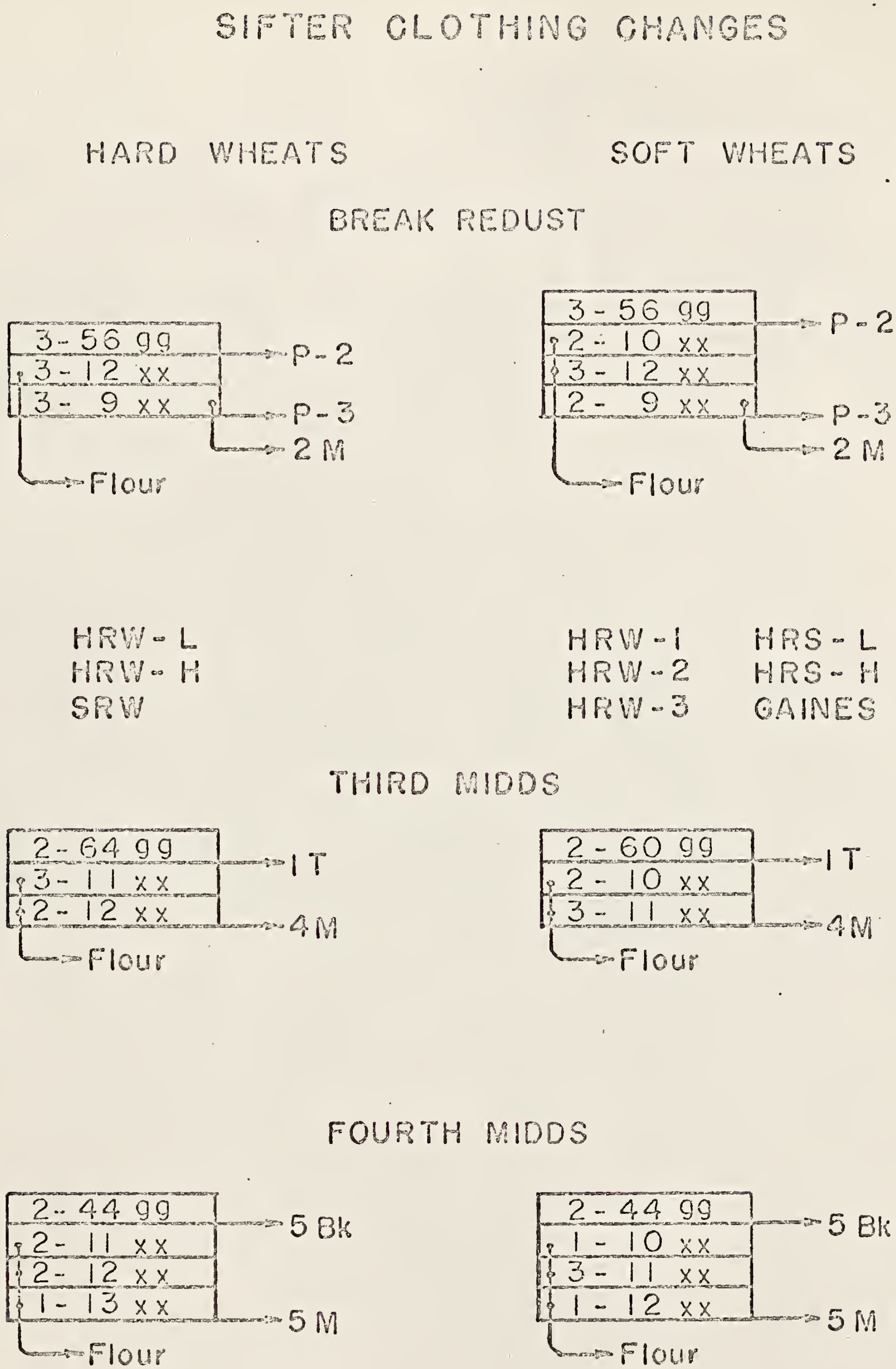



Fig. 1. Sifter clothing changes.

All the corrugated rolls (break rolls except pre-break) in the pilot mill ran with a 2 1/2 to 1 differential. The corrugations as indicated on the flow sheets (Plates I, II, III, IV, and V) were the same throughout this study. All the smooth rolls in the pilot mill ran at 1 1/2 to 1 differential with the exception of 2Q and 1Z which ran at 1.2 to 1 differential. The measured roll speeds of all the rolls are given in Table 4.

The amount of milling equipment used (rolls, sifters, and purifiers) appears in Tables 4 and 5.

The Break System

The break grinding system of the pilot flour mill is made up of eight pairs of rolls divided into a pre-break using smooth rolls, and five breaks with corrugated rolls. Two pairs of rolls, one pair grinding coarse stock and the other grinding finer stock were used for both third and fourth break. A separate duster was used on bran and one for shorts to complete the extraction of endosperm from bran.

The pre-break rolls were adjusted so that the kernels were just cracked along the crease. There was no attempt to release any endosperm from the kernel. The pre-break rolls are used only to prepare the kernel so that the first break rolls are able to release cleaner middlings.

The remainder of the breaks were adjusted by the use of a laboratory sifter to determine the break release obtained. The break rolls were set from head to tail of the mill, by adjusting either end of the rolls until they were grinding uniformly along their entire length. Then if necessary the entire roll was adjusted to obtain the desired release. The break

Table 4. K.S.U. Pilot Flour Mill, 200 cwt/24 hours, equipment allocation.

| Stock | Roll Dia. (in.) | Length (in.) | Inches per cwt. | Roll speed rpm. | | Sifter section | Number of sieves | Sq. ft. | Sq. ft. per cwt. |
|---|---|---|---|---|---|---|---|---|---|
| Pre Bk | 9.84 | 23.6 | .118 | 263 | 114 | 1/4 2x14 | 12x1/2 | 15.6 | .078 |
| 1 Bk | 9.84 | 23.6 | .118 | 245 | 98 | 1/4 2x14 | 12x1/2 | 15.6 | .078 |
| 2 Bk | 10. | 24. | .120 | 300 | 120 | 1/4 2x14 | 12x1/2 | 15.6 | .078 |
| 3 Bk F | 8.67 | 15.75 | .079 | 266 | 104 | 1/4 2x14 | 12x1/2 | 15.6 | .078 |
| 3 Bk C | 8.67 | 15.75 | .079 | 376 | 147 | | | | |
| 4 Bk F | 8.67 | 15.75 | .079 | 281 | 112 | 1/4 2x14 | 13x1/2 | 16.9 | .084 |
| 4 Bk C | 8.67 | 15.75 | .079 | 265 | 104 | | | | |
| 5 Bk | 8.67 | 15.75 | .079 | 280 | 146 | 1/4 2x14 | 13x1/2 | 16.9 | .084 |
| Bk red | --- | --- | --- | --- | --- | 1/4 2x14 | 8 | 20.8 | .104 |
| B.&S.D. | --- | --- | --- | --- | --- | 1/4 2x14 | 8 | 20.8 | .104 |
| C. Siz | 10. | 24. | .120 | 300 | 120 | 1/4 2x14 | 14x1/2 | 18.2 | .091 |
| F. Siz | 10. | 16. | .080 | 316 | 206 | 1/4 2x14 | 12x1/2 | 15.6 | .078 |
| 1 M | 10. | 16. | .080 | 316 | 203 | 1/4 2x14 | 12x1/2 | 15.6 | .078 |
| 2 M | 8.67 | 15.75 | .079 | 370 | 255 | 1/4 2x14 | 14x1/2 | 18.2 | .091 |
| 2 Q | 7. | 16. | .080 | 310 | 212 | 1/4 2x14 | 7 | 18.2 | .091 |
| 3 M | 9. | 12. | .060 | 300 | 205 | 1/4 2x14 | 7 | 18.2 | .091 |
| 1 T | 7. | 16. | .080 | 310 | 212 | 1/4 2x14 | 7 | 18.2 | .091 |
| 4 M | 9. | 12. | .060 | 239 | 167 | 1/4 2x14 | 6 | 15.6 | .078 |
| 5 M | 9. | 12. | .060 | 301 | 211 | 1/4 2x14 | 6 | 15.6 | .078 |
| 6 M | 9. | 12. | .060 | 300 | 205 | 1/4 2x14 | 6 | 15.6 | .078 |
| Suc | --- | --- | --- | --- | --- | 1/4 2x14 | 7 | 18.2 | .091 |
| TOTAL | | 301.70 | 1.510 | | | | | 325.0 | 1.625 |

Table 5. Purifiers in the 200 cwt K.S.U. Pilot Flour Mill.

| Purifier | Sieve area (ft$^2$) | Sq. ft. per cwt. |
|---|---|---|
| 1 | 9.50 | .0475 |
| 2 | 9.50 | .0475 |
| 3 | 6.79 | .0340 |
| 4 | 6.79 | .0340 |
| 5 | 5.27 | .0264 |
| 6 | 5.27 | .0264 |
| 7 | 5.00 | .0250 |
| TOTAL | 48.12 | .2408 |

release was determined by sifting a 100 gram sample for 30 seconds over a 20 TT sieve. The overs of the sieve were weighed and subtracted from 100 percent (grams) to obtain the percent released. The same break release schedule (Table 6) was used in all the tests.

Table 6. Through 20 TT.

| | |
|---|---|
| 1 Bk. | 30% |
| 2 Bk. | 40% |
| 3 Bk. F. | 30% |
| 3 Bk. C. | 55% |
| 4 Bk. F. | 30-35% |
| 4 Bk. C. | 20% |
| 5 Bk. | 30% |

The Reduction System

The reduction system of the pilot mill consisted of two sizings operations, six middlings, a second quality, and a first tailings sections.

The two sizing sections were divided into coarse sizings and fine sizings. There was no attempt in either sizing section to produce any flour. They were both adjusted for the purpose of reducing the size of the coarse middlings produced by the breaks and to remove and bran specks still adhering to the middlings. In so doing, the function of the sizings sections was three fold: 1) to flatten the germ so that it could be removed from the middlings as soon as possible; 2) to facilitate further cleaning of middlings by a purifier; and 3) to reduce the size of the coarser middlings so that the stock sent to the middlings rolls was of more uniform particle size.

The rolls of each of the six middlings sections were adjusted for maximum flour production without creating excess heat or flaking of the endosperm.

The second quality and first tails sections were adjusted for a purpose similar to that described for the sizing sections. The pilot mill was flowed so that the germ was concentrated at the first tailings rolls. Flattening the germ so that it could be removed to the germ separator by tailing over a 32 GG sieve in the 1T sifter was a major consideration in the adjustment of the first tailings rolls.

After the break rolls were all adjusted and operating properly, the reduction rolls were checked and set from head to tail of the system. The adjustment of the reduction system was governed largely by the appearance and feel of the ground stock as judged by the miller.

Bolting and Purification

As was mentioned previously (Fig. 1) it was necessary to use coarser flour cloths in some of the sifters while milling the soft wheats than when milling the hard wheats. These sifter clothing changes were kept to a minimum in the break system by leaving the break sifters unchanged with the exception of the first, second, third break reduct sifter where 10xx flour cloths were added to the three 12xx flour cloths which were always used for milling hard wheat.

After the SRW wheat was milled, analysis of the data indicated that too much flour had tailed over the flour cloths of the reduction sifters and ended up in red dog. To correct this situation when Gaines was milled the third and fourth middls flour cloths were coarsened (Fig. 1). It was found that the coarser cloths in the 3M and 4M sifters were not detrimental to hard wheat milling and so they were left coarser when milling the remaining hard wheats (all the hard wheats except HRW-L and HRW-H).

The allocation of sifter surface by system is given in Table 4.

The purification system was made up of seven purifiers. The distribution of the available purifiers is shown in Table 5. The purifiers remained unchanged throughout the tests except that the air flow was varied in an attempt to keep the mill as nearly the same balance as possible. As was pointed out in a previous section of this report, the adjustment of the purifiers can be a very important factor in controlling the balance of flow in the mill.

## Sampling

The mill was started and allowed to run until tempered wheat had spread throughout the mill. The rolls and purifiers were then adjusted in the manner already described. When the mill had stabilized and was running evenly the adjustments were rechecked and reset if necessary. After the mill was in balance and running in a steady state the sampling process was begun.

The pilot mill was spouted so that all the flour streams flowed to a common sampling point where the individual flour stream samples of every flour stream in the mill could be taken in unison. These individual flour stream samples were collected over a five minute period. Immediately after collection the samples were weighed and bottles of each were tightly capped until the analyses could be run. The stream weights were recorded as grams per five minutes. The flour streams were sampled before and after the various other streams from each of the sifters and purifiers were sampled.

The remaining streams from the sifters (the flour streams were not re-sampled at the sifter) and the purifiers were sampled one system at a time in the reverse order of flow from the tail to the head of the mill. In this way each system to be sampled was not affected by the removal of the sample just collected. The streams flowing from the sifters were sampled by removing the socks beneath the sifter box and running the streams into sacks for five minutes. These samples were quickly weighed and smaller samples of each were bottled for analysis. The purifiers were sampled in a similar manner. The weights were recorded in grams per five minutes.

The four feed streams were weighed during the entire milling run on each wheat and saved for analysis. The pilot mill makes four millfeeds, bran, shorts, germ, and red dog. The shorts, germ and red dog were sacked off separately from the bran during the entire run on each wheat. The total weight of each stream was recorded. Later a representative sample of each was blended in a horizontal batch mixer and smaller samples were taken for analysis.

The bran stream was sampled for five minutes three times each hour. The rest of the bran was run into a hopper scale where the total weight was recorded. The sacked samples were later blended in a horizontal batch mixer and sampled for analysis.

The entire mill was sampled during the milling of HRS-H, HRS-L, Gaines, and SWW. Only flour and millfeed streams were sampled for weight and analysis during the milling of the hard red winter wheats. The stream weights and analyses already reported (10) from the pilot mill were used in this study as representative of hard red winter wheats.

Methods of Analysis of Streams and Wheat

The moisture, ash, and protein of each sample were determined by procedures 44-15, 08-11, and 46-11, respectively, in "Cereal Laboratory Methods" (6).

Test weights were determined using a one quart kettle and a beam balance in accordance with the standard method outlined by the United States Department of Agriculture (40).

The 1000 kernel weight was obtained by the use of an electronic seed counter to determine the number of kernels in a 40 gram sample. The count per 40 grams was then used to calculate the weight per 1000 kernels.

The pearling values were determined by pearling a 20 gram sample in a Strong-Scott barley pearling machine for 60 seconds. The pearled sample was then removed and sifted over a 20 wire sieve in a Smico laboratory sifter for 30 seconds. The portion of the samples remaining above the 20 wire was then weighed and recorded as a percent of the 20 gram sample.

## Methods of Analysis of Performance Data

Rozsa (32) presented flour production data on an entire mill. All the data was given in the form of tables. Later, Rozsa (33, 34) again presented the same data on the same mill but by the use of graphs. By so doing he pointed out the fact that the large quantity of data involved in considering a commercial flour mill as a single production unit are far more easily grasped in the form of a graph than in a table. A graph can show at a glance what tables yield only after some considerable study. For this reason much of the data obtained by this study has been represented graphically.

Rozsa (33, 34) stated that the granulation curves of a given mill should not vary once they have been established in optimum performance conditions.

Farrell and Ward (10) pointed out the value of granulation curves in the design and analysis of a flour mill. They made use of the predictability of granulation within a mill to predict flow rates. Gehle (13) discussed a procedure of evaluating pneumatic conveying systems by expressing the quantity conveyed in each line (flow rates) as a percent of the load to the first grinding operation. Fairchild (9) used a similar method to evaluate pneumatic mills with different arrangements of milling machines. In the study, Fairchild used the Kansas State University Pilot Flour Mill as a basis for comparing various arrangements of equipment on single or multi-story buildings.

Break granulation data was also analysed using methods similar to those standardized by the American Society of Agricultural Engineers (12) for computing modulus of fineness and modulus of uniformity. Since a standard set of sieves was not used to determine the granulation data some modifications were necessary. Each separation coming from the sifters was expressed as a percent of the total stock flowing from the sifter. Each separation was multiplied starting with zero times the finest separation and increasing the multiplier by one for each coarser separation. The products were then summed and the total represents the modulus of fineness as used in this study.

The modulus of uniformity was computed by dividing the sifter separations into three categories coarse, medium, and fine. The coarse stock varied from the overs of a 22 TT to the overs of an 18 TT. The medium stock varied from thru an 18 TT and over 38 GG to thru 22 TT and over an 8 XX. All which passed the finer cloth of the medium range was called fine. The percent of stock in each size range was summed and divided by 10. The quotients, to the nearest tenth, were expressed as a ratio in the form, coarse to medium to fine.

The cumulative ash curve can be a valuable tool in the evaluation and operation of a flour mill. It can be used to evalute the performance of a particular mill on different wheats or to relate the performance of several mills all milling the same wheat. Cumulative ash curves of total flour production are most often plotted with the cumulative percent of yield (total products in this study as the abcissa and the cumulative percent of ash as the ordinate).

When plotted, the cumulative ash of all the component streams of a straight grade flour should remain fairly flat (increasing slightly) until the cumulating percent yield approaches the percent of straight grade flour produced. As the total yield is approached the cumulative ash should turn upward more rapidly. Once a mill is established in the production of a respectable flour yield at a reasonably low straight grade flour ash the cumulative ash curve can be used to evaluate future milling on that particular mill.

The cumulative ash curve and the accompanying data are also used to determine the rate of production of various flour grades to a specified ash level. It is in this use that the economic desirability of the cumulative ash curve shaped as just described in the previous paragraph becomes quite apparent. Low ash patent flour demands a price premium so the longer the cumulative ash stays low (relatively level curve) the more patent flour is available.

The various data from hard red winter wheat milling on the Kansas State University Pilot Flour Mill were used as the standard or control during this study. This data was taken both from wheat milled in this study and from data previously published by Farrell and Ward (10).

## RESULTS AND DISCUSSION

Data for all the streams and the mill are given in Appendix A to this paper. It was necessary to work at all times with flow rates as a percent of either the wheat to the mill of the stock from the individual system, because the various wheats were milled at different rates.

The cumulative ash curves of all 23 individual flour streams comprising the straight grade flour from each of the wheats were plotted on one graph (Fig. 2) to allow close comparison. The curves remained relatively flat (slow increase in ash) out to the range of total products yield with the

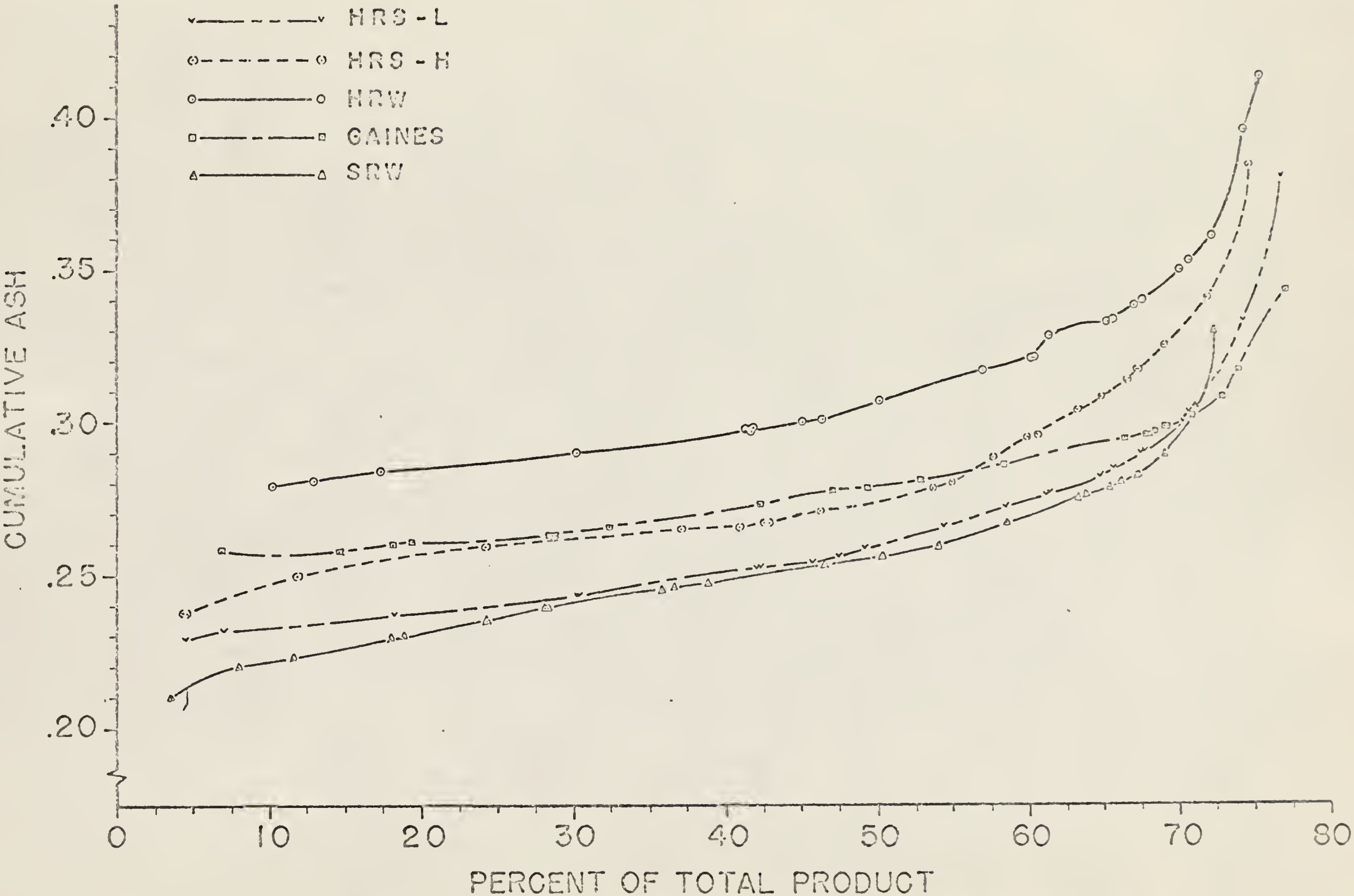



Fig. 2. Cumulative ash curves of all the componet flour streams from each wheat included in this study.

exception of HRS-H. The curve of the HRS-H flour turned upward too soon indicating a percent of total products yield. This was probably due to a combination of two factors. The kernels were small (Table 2, 41.5% over a 7 W and 22.9 grams per 1000 kernels) so the amount of available endosperm was reduced and the granulation curves indicate probable error in break roll adjustment. Though the rest of the curves were favorably shaped, they were well scattered with no apparent grouping of class or type (hard or soft).

The ash of the wheats (Table 2) and as the cumulative ash curves show, the ash of the various flours produced were appreciably different, one from another. Thus it would be impractical to compare the ash of an individual flour stream from each of the wheats. But since the flour streams are ordered according to ascending ash in computing cumulative ash (Appendix B) it is reasonable to compare the relative positions of an individual stream in the different wheat millings. Though the positions of the streams in the cumulative ash list are by no means constant, they do fix themselves in a general area on the list. The first and second midds streams and the sizings streams normally arrange themselves near the top of the list. Either first midds top or first midds bottom is usually lowest in ash. The bran and shorts duster flour was always the highest ash flour (bottom of the list) with fifth break and sixth midds usually next above it. Most of the other streams have nearly the same positions in the list.

Several streams in the cumulative ash list for SRW were outside of their usual range of positions. The most noticeable is sixth midds flour, which is much higher in the list because it was lower in ash than normal.

The quantity (as percent of total products) of sixth midds flour was also above average (Fig. 11, and Table 14). This was due to the inefficient removal of the soft wheat flour as it was made earlier in the entire milling process. Since much of the flour made was not sifted through the flour cloths it continued to tail over and move toward the tail of the mill where it eventually ended up at sixth midds and thence in the red dog bag.

Some other streams which were out of their normal range of positions were fifth midds flour in the SRW (it was high in the list and in quantity as was sixth midds flour, though not as radically so) and third midds flour in both the soft wheats was lower (higher in ash) in the list than usual. This is not easily explained since the material sent to third midds was no higher in ash than in other cases. First and second break flours were slightly higher in the list (lower in ash) in the soft wheats than normal when milling hard wheats. Second break of the SRW was higher in the list and lower in ash than when any other wheats were milled.

Granulation curves showing particle size vs. percent of the system being plotted were graphed (Figs. 3, 4, 5, 6) for the first three breaks and the break redust section. The curves for first break (Fig. 3) show very little difference in granulation between the wheats except that HRS-H was considerably coarser (low break release) than the rest. This same trait followed that wheat in all the breaks. The seemingly under-adjusted breaks were probably responsible for the shape of the cumulative ash curve. HRS-H rose too rapidly at a relatively low percent of total products, as mentioned previously. On the first break sifter (Fig. 3) the SRW was highest

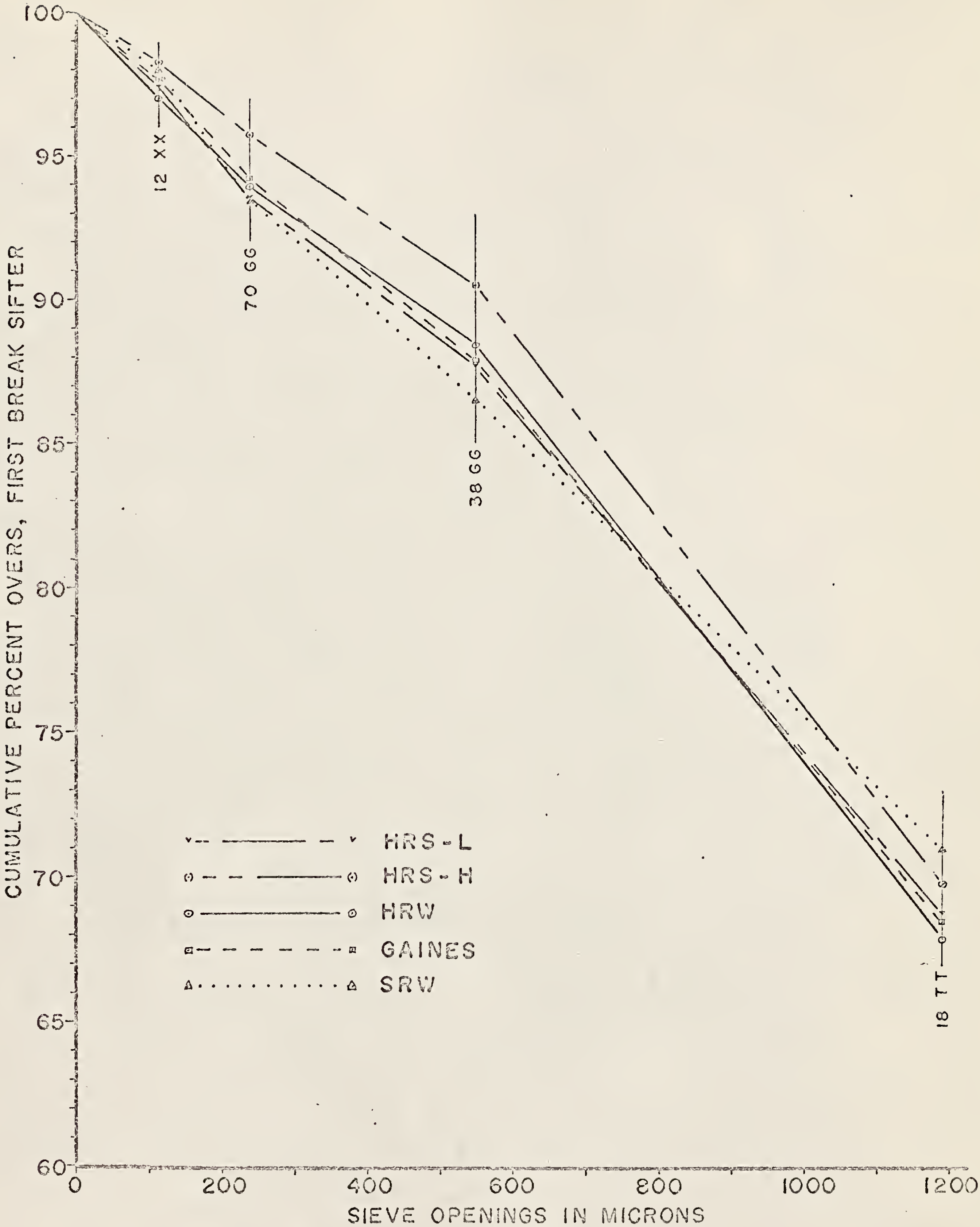



Fig. 3. Granulation curves of stock flowing from first break sifter.

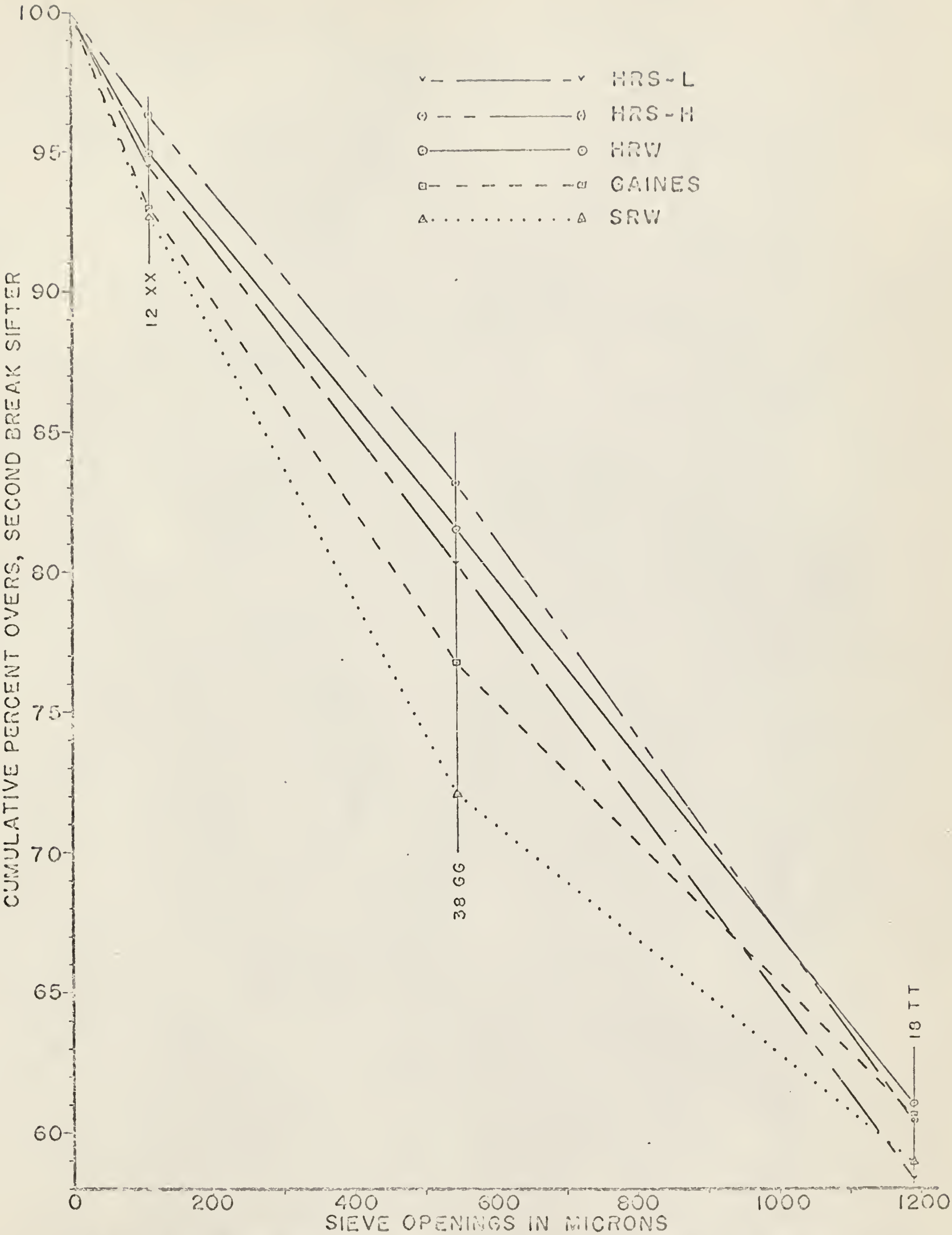



Fig. 4. Granulation curves of stock flowing from second break sifter.

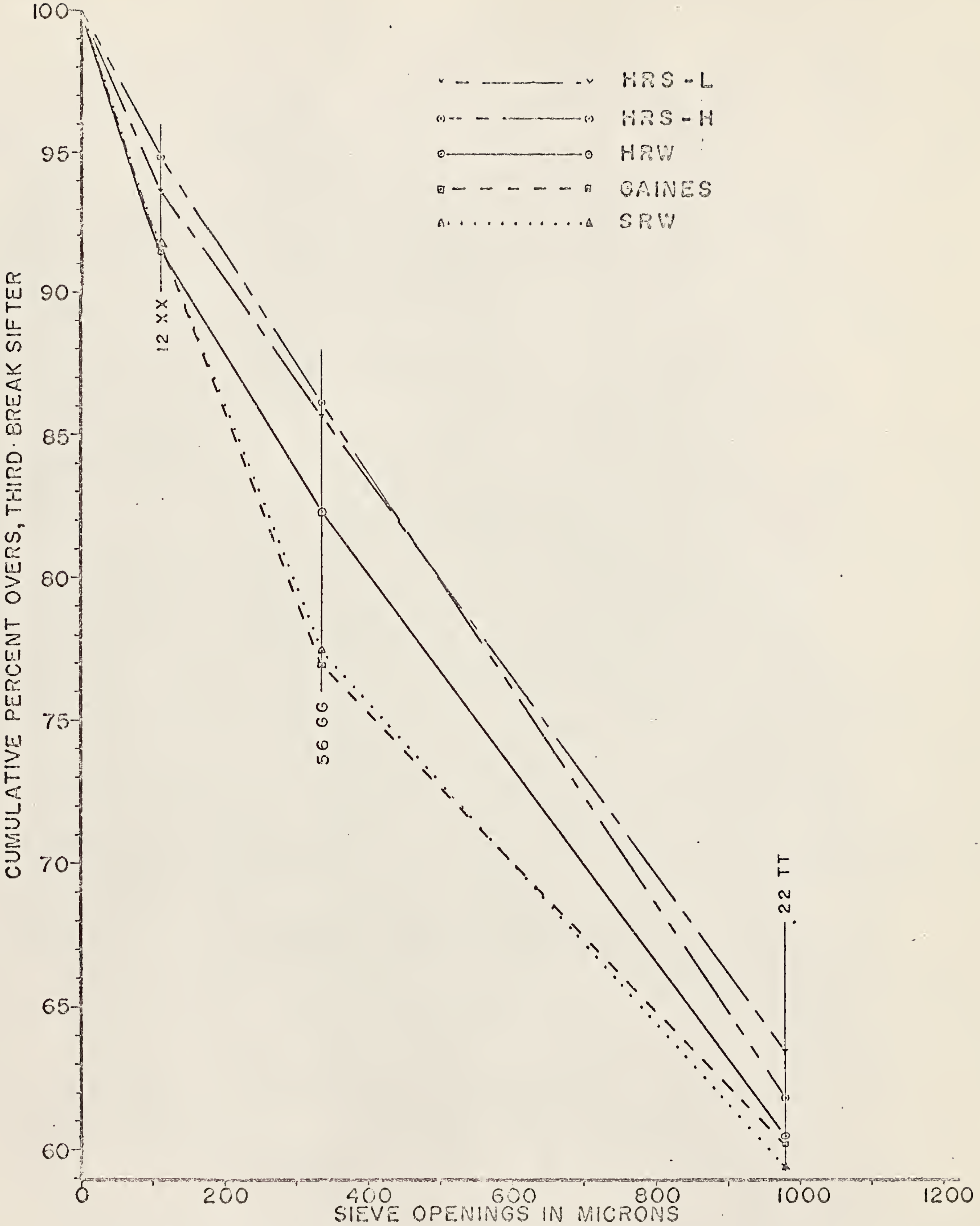



Fig. 5. Granulation curves of stock flowing from third break sifter.

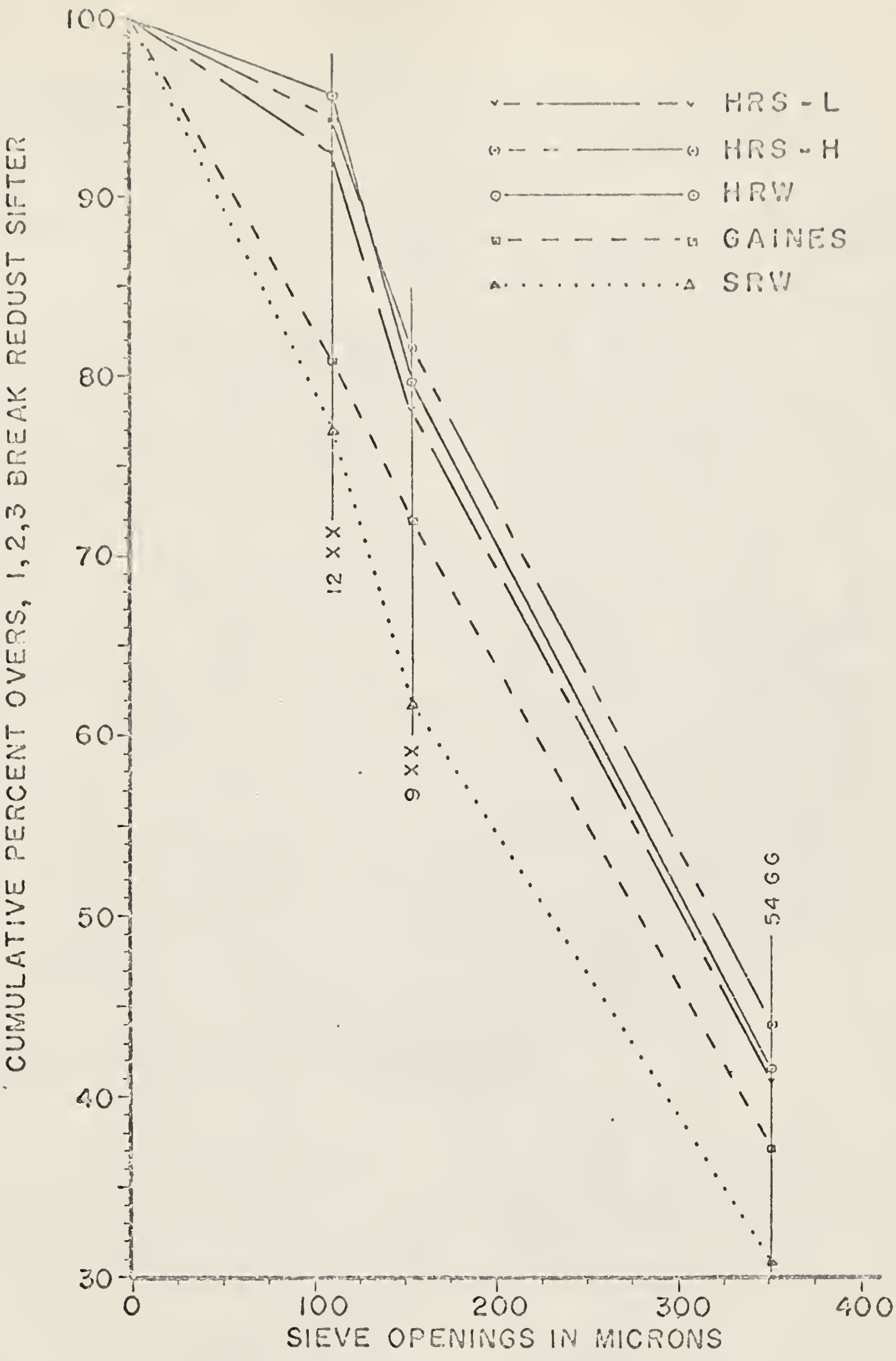



Fig. 6. Granulation curves of stock flowing from break redust sifter.

in percent over the 18t. (largest bran particles) and at the second sieve (38GG) it had the finest granulation in comparison to the other wheats. This indicates a relatively small amount over the 38GG as shown in Fig. 9 and Table 14. Comparing the total stock as percent of wheat (Tables 10, 11, 12, 13, 14) sent to P-1 during each milling, the data indicates that the soft wheats produced less coarse sizings than HRW. The spring wheats produced about the same or more coarse sizings than the HRW.

It was noticed that except for the HRS-H all the granulation curves of first break (Fig. 3) crossed the curve for SRW at about 800 to 825 microns size range. It was not determined in this study whether this was due to the relation of the milling sifter to the laboratory sifter used in adjusting bread releases or if it was simply caused by the differences in granulation. The importance of this graph (Fig. 3) was that there was little difference between the granulation of the classes of wheat. Also of importance was that they were not sufficiently different from a straight line approximation that mill balance might be affected by such an approximation.

The granulation curves of second and third breaks (Figs. 4, 5) show increasing differences in granulation between the classes of wheat. The soft wheats (SRW more than the Gaines) show the production of more fines than the hard wheats, with the spring wheats being the most coarse. This can be explained as the result of differences in the hardness of the endosperm of the various classes of wheat. The SRW, being the softest, reduced the fastest (making the most break flour), and the hard red spring wheats reduced the slowest.

The granulation curve of the break reduct section would be expected to look like that for the hard wheats (straight, up to the flour cloth then leveling off sharply) since the flour should already have been removed. The concentration of stock passing over the 54gg and the 9xx of the break reduct section is also shown in the bar graph of the break reduct section (Fig. 9). This was evidently not the case for the soft wheats (SRW yielding nearly six times as much break reduct flour as the HRW. The break flour removed in the break reduct section of the soft wheat flows indicates incomplete sifting in the break sifters. That would account for the bowed shape of the soft wheat granulation curves for second and third breaks (Figs. 4, 5).

The granulation curves of the five breaks were plotted as a percent of the wheat sent to the mill (Figs. 7, 8). These curves seem to indicate the opposite of the granulation curves based on stream weight as a percent of the system. That is, in Figs. 7 and 8, there is more similarity between the granulation of the soft wheats and HRW than between the two classes of hard wheats (HRW and HRS). It is suspected that the true granulation curves of the soft wheats are not represented by these curves (Figs. 3, 4, 5, 6, 7, 8). What is represented by the curve is the actual separation of the break sifters on the soft wheats, not what could have been separated.

The lowered efficiency of the break sifters on soft wheats is clearly evident in the granulation curves of second and third break (Fig. 8). The curves for the HRW are straight, up to the flour cloth (12xx, 110 microns), then it steepens. This is because of the proportion of flour to the coarser particles. The same is true of the spring wheats (Fig. 7). But the increase

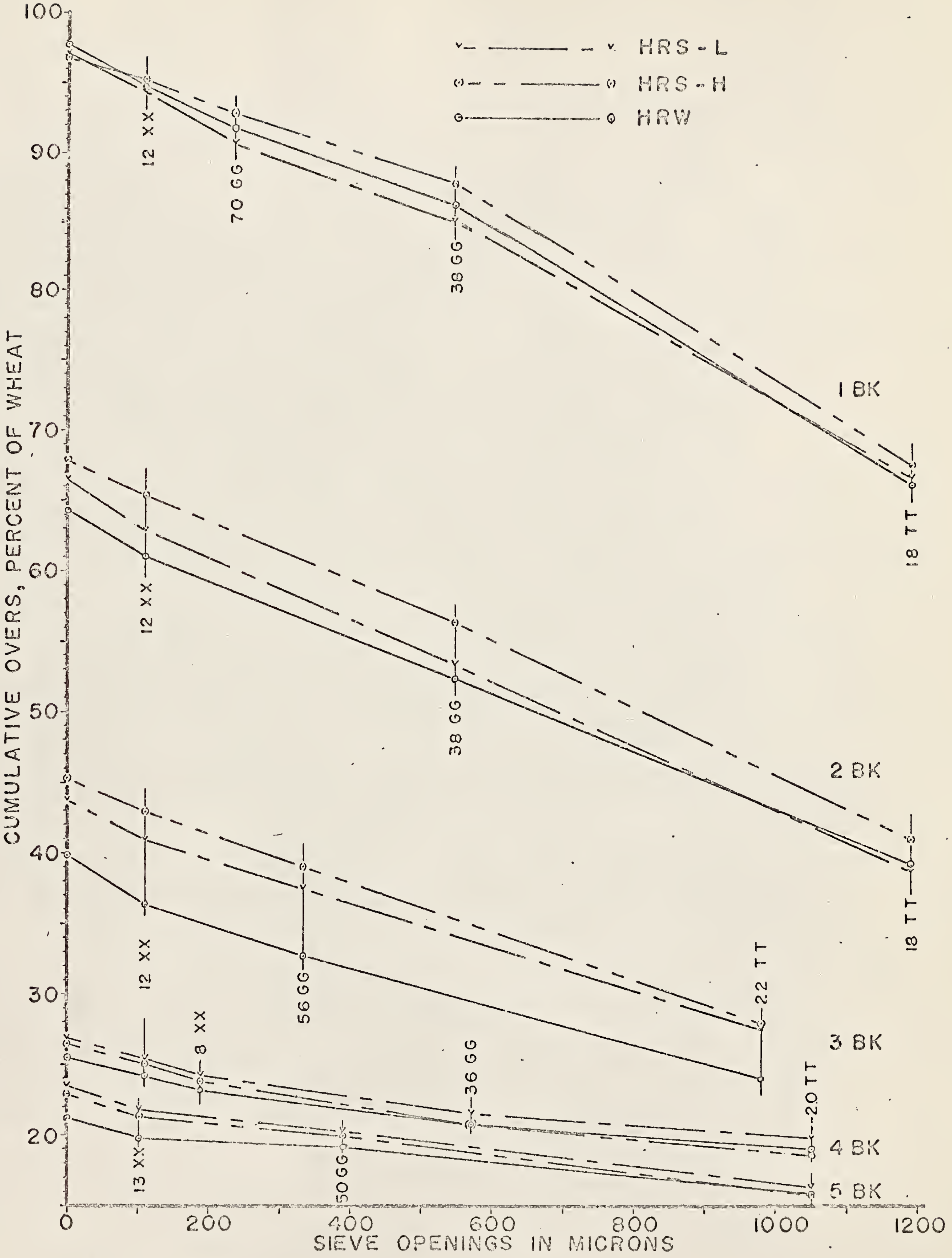



Fig. 7. Granulation curves of break stock as percent of wheat.

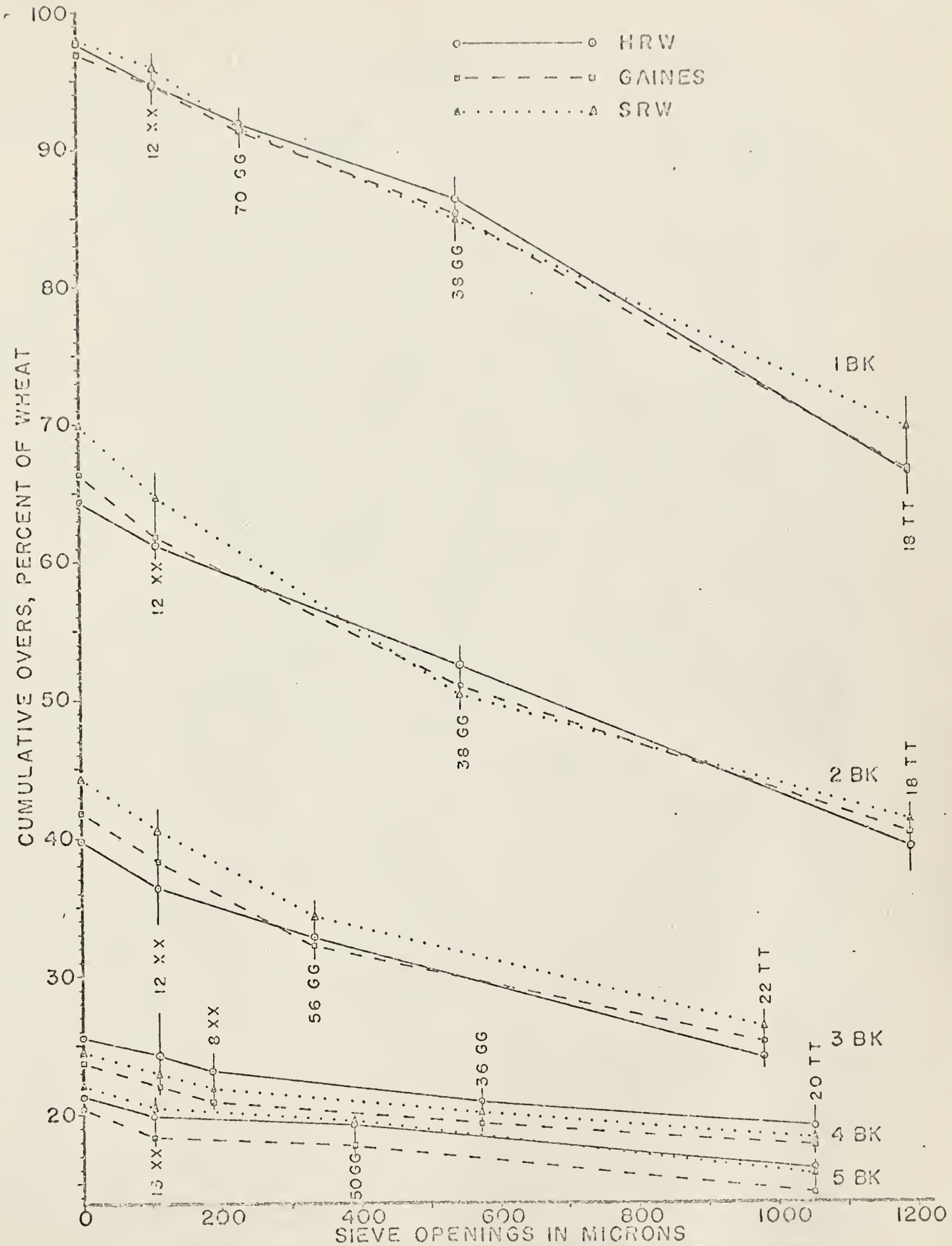



Fig. 8. Cumulation curves of break stock as percent of wheat.

in steepness is less since the spring wheats are slightly harder to reduce and thus made less break flour. The point of change in the slope of the soft wheat granulation curves came at the first sieve coarser than the flour cloth (second break- 38gg, 546 microns, and third break- 56gg, 333 microns). This was because the removal of the break flour was incomplete and the flour left had to tail over the flour cloth with the coarser particles. The soft wheat curves, as determined from the sifter sampling, are nearly parallel to the HRW curve in flour production. They should, however, be much steeper since more break flour from soft wheat was available to be removed but was not completely removed.

Inspection of the bar graphs of the break reduct section (Fig. 9) indicates that the break sifters were quite successful in removing the flour from the ground hard wheat stocks. The same graph also shows that the same sifters were quite inefficient in removing the flour produced by the breaks in the milling of soft wheats. Thus Figs. 7 and 8 represent only the actual sifting capability of the break sifters on soft wheat relative to that on HRW.

In the case of the hard wheats, 60tt HRS and HRW, the granulation curves of the breaks (Figs. 7 and 8) do approach a straight line closely enough to permit such an approximation for the purpose of estimating flow rates in the design of new milling systems (18). This does not appear to be true however for the soft wheats. Had the break flour which was produced been removed by the respective break sifters with the same efficiency as the sifters showed on the hard wheats the break granulation curves would have been quite different for the soft wheats. They would have been more concave than they were. The left hand half, the fine end of the curve, would have been steeper showing a greater increase in production of fines (break flour and fine middlings) compared to the hard wheats (42) than was indicated by the actual sifter separations. The right hand half of the curve would then have been flatter.

This being true, the straight line approximation of the granulation curve for soft wheats would not be satisfactory. A soft wheat flow or an actual system designed on such a basis would be under-designed to handle the fines and over-designed for handling the coarser break stock.

Cumulating the overs of the sieves as was done in plotting the granulation curves (Figs. 3, 4, 5, 6, 7, 8) sometimes tends to average out the actual differences in granulation. If for example the percent of stock over the first sieve in a stack of sieves is small and the percent over the second sieve is large. The cumulative percent of overs of the first and second sieves may then be on the average when actually each was quite different. For this reason bar graphs of the overs of each sieve were plotted (Figs. 9, 10, 11, 12) as a percent of the wheat sent to the mill.

Modulus of fineness and modulus of uniformity are two methods which are often used to describe the granulation characteristics of ground stock numerically. Modifications of these methods were used to compute numerical representations of the granulation of break stock (Tables 7, 9). These tables show very clearly that less sizings and more fine middlings and flour were produced by the softer wheats than by the hard wheats. Two graphs (Figs. 13, 14) plotted from the data of Tables 8 and 9 show the decrease in sizings production going from the HRW wheat through SRW wheat.

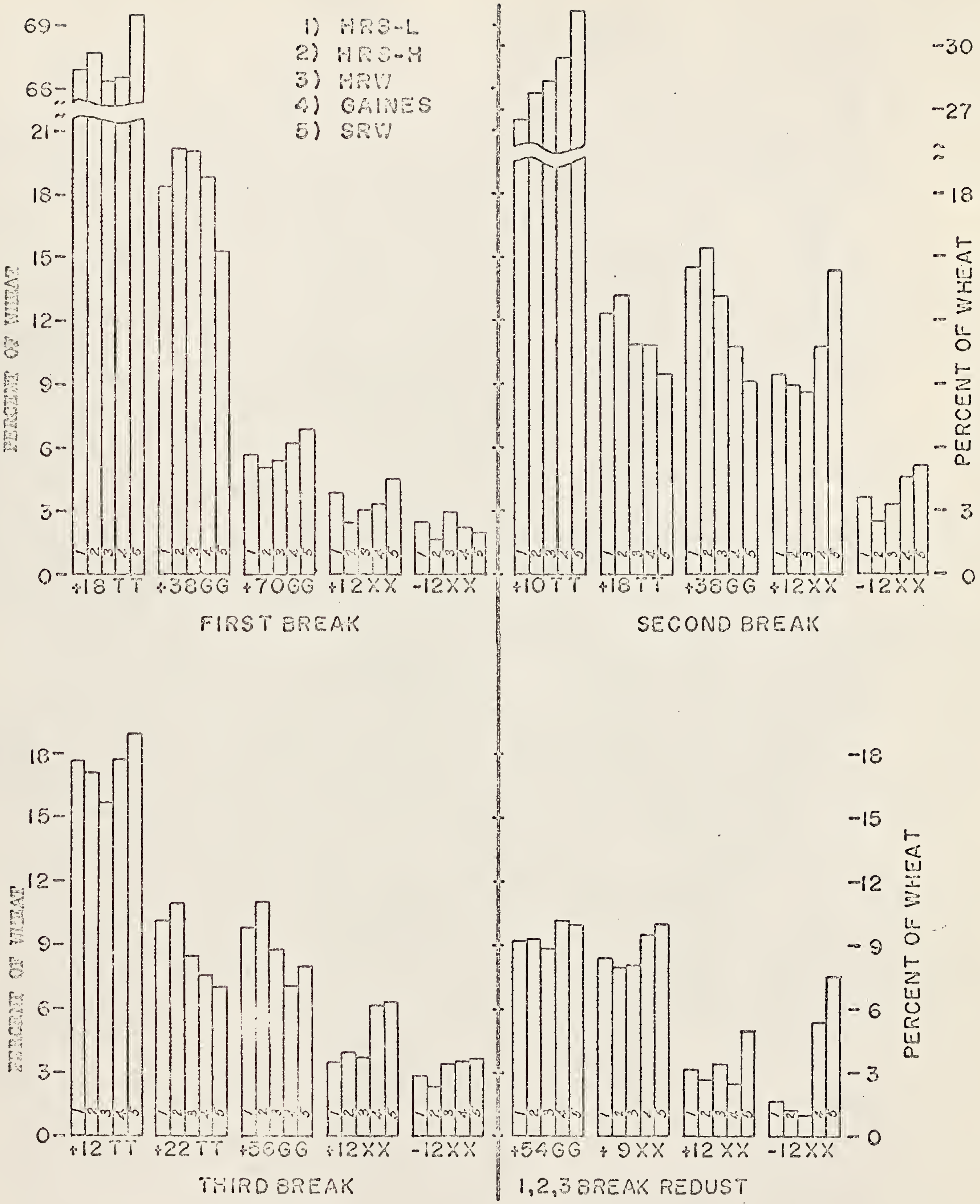



Fig. 9. Individual stream weights as a percent of the wheat to the mill.

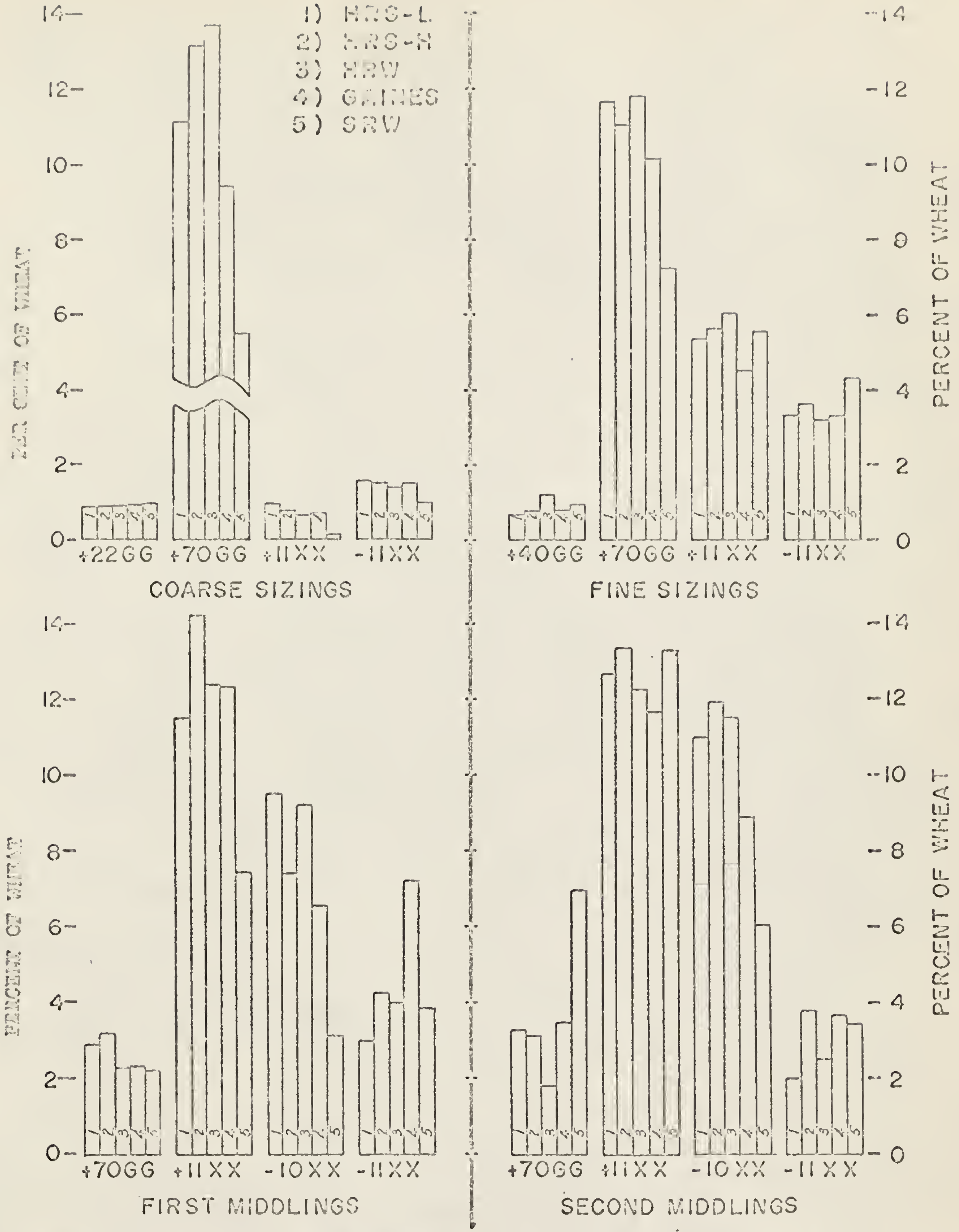



Fig. 10. Individual stream weights as a percent of the wheat to the mill.

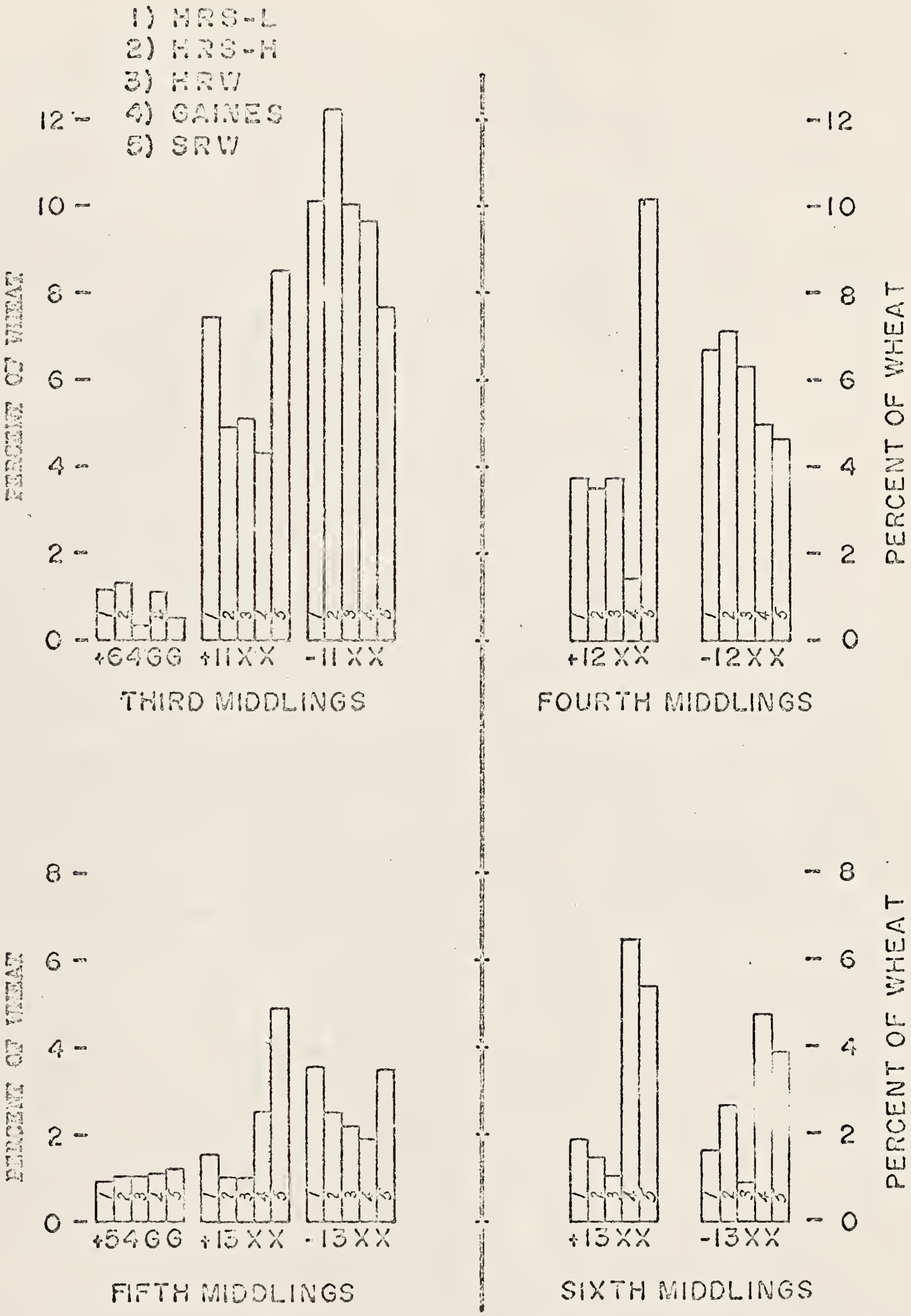



Fig. 11. Individual stream weights as a percent of the wheat to the mill.

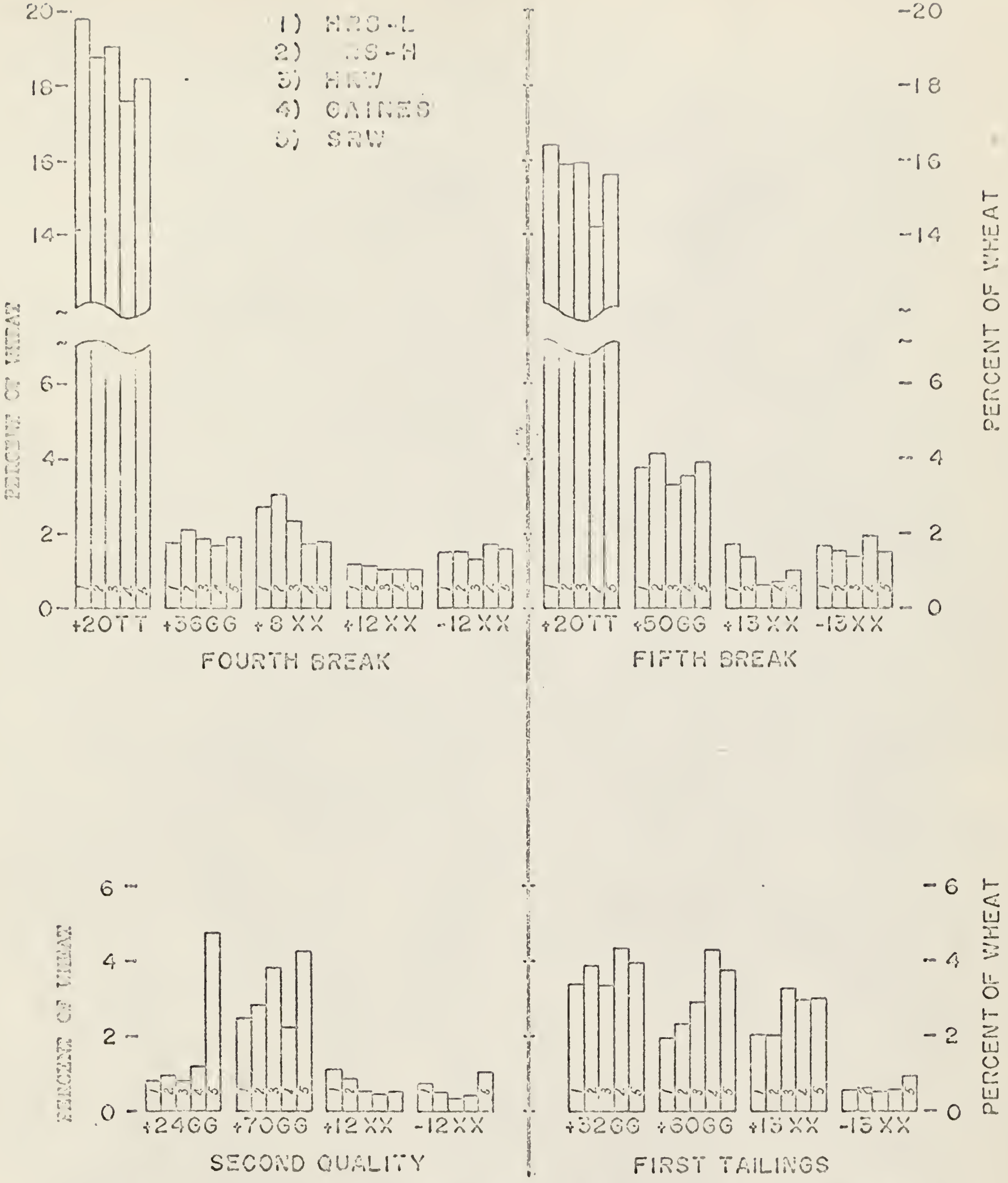



Fig. 12. Individual stream weights as a percent of the wheat to the mill.

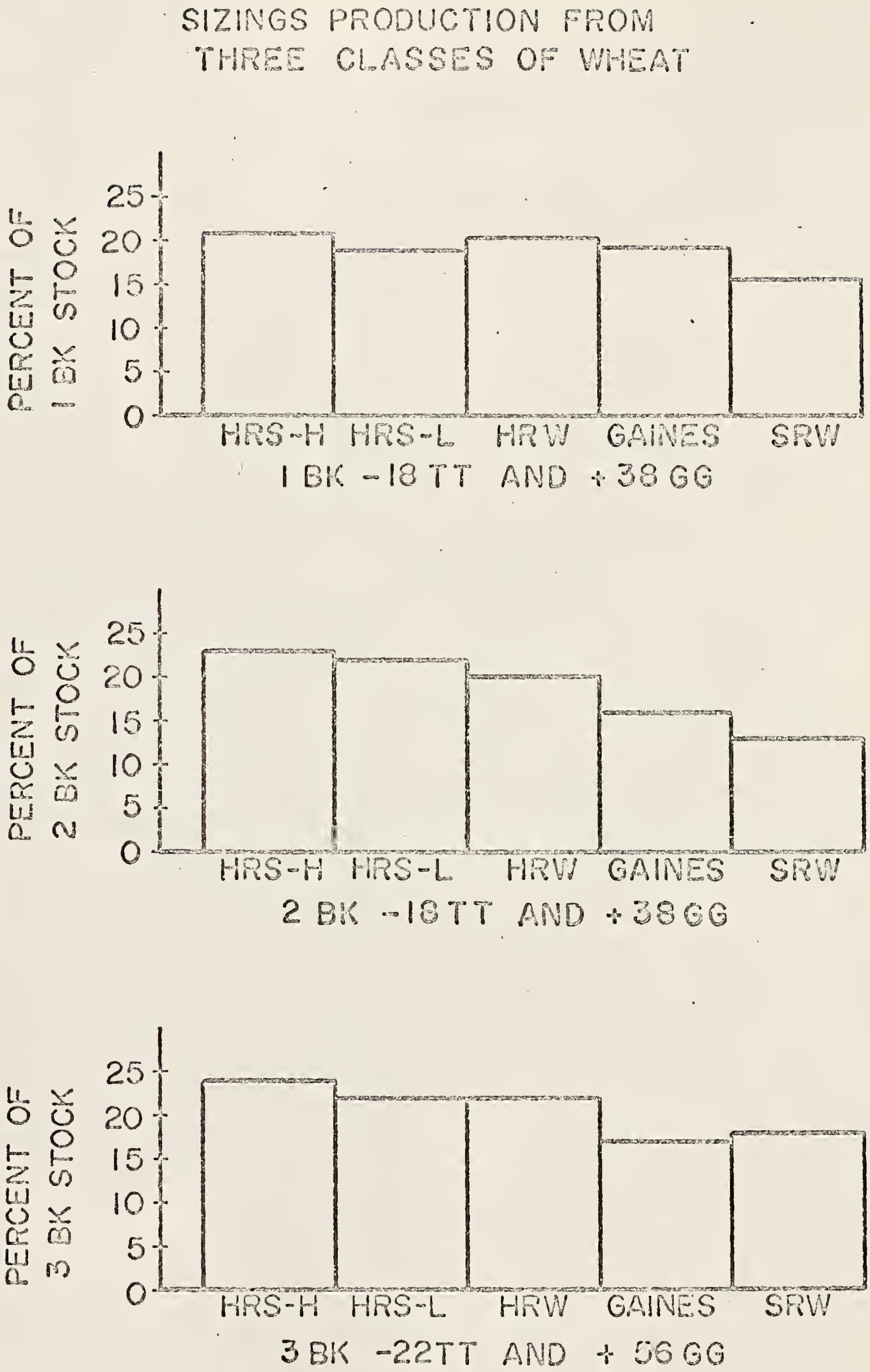



Fig. 13. Sizings production from three classes of wheat.

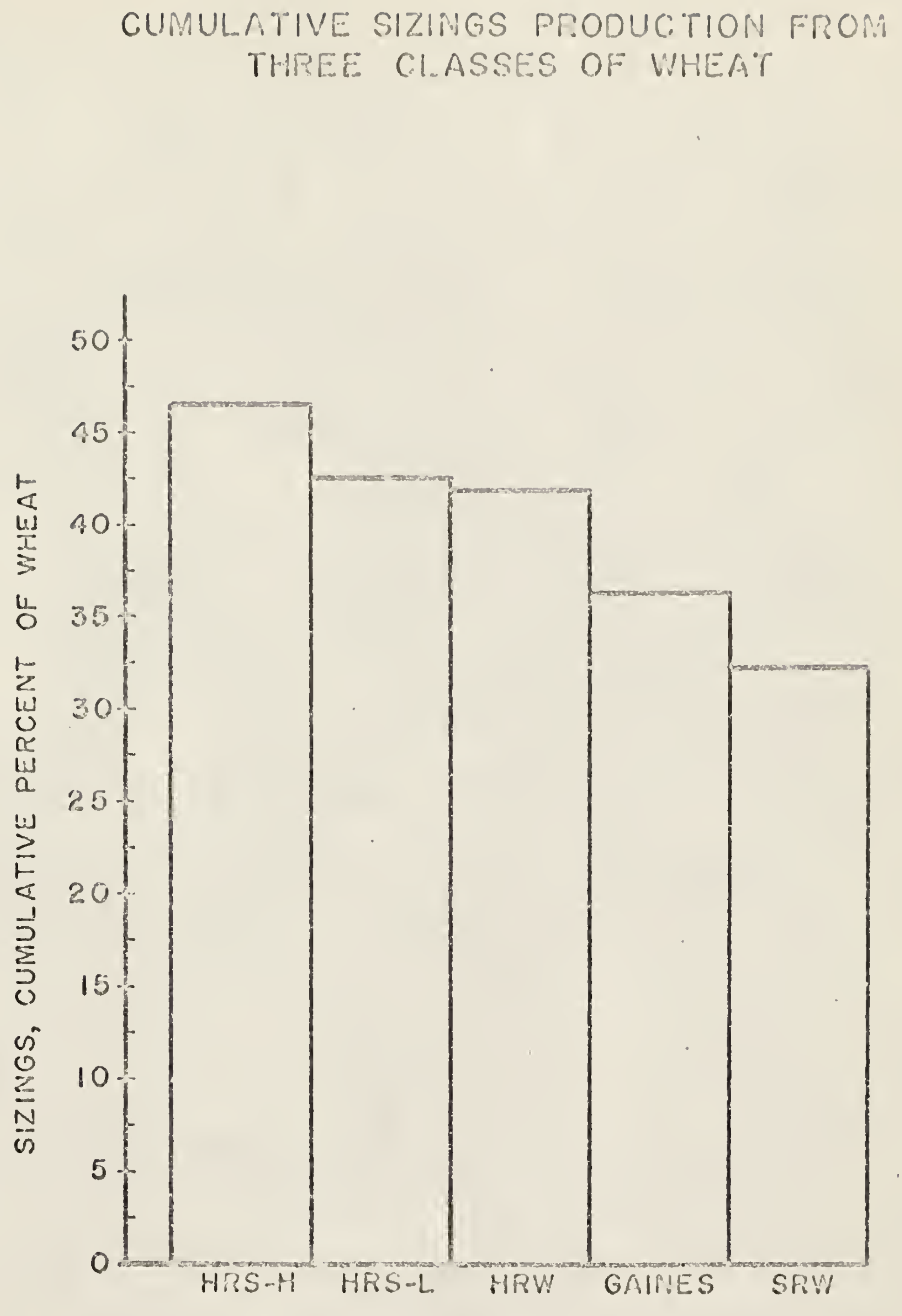



Fig. 14. Cumulative sizings production from three classes of wheat.

Table 7. Modulus of fineness of break stocks.

| | Break | | | | | |
|---|---|---|---|---|---|---|
| Wheat | 1 Bk. | 2 Bk. | 3 Bk. | Bk Red | 4 Bk. | 5 Bk. |
| HRS-H | 354.3 | 280.8 | 280.5 | 219.8 | 333.6 | 245.0 |
| HRS-L | 347.4 | 273.0 | 283.0 | 211.5 | 338.4 | 248.4 |
| HRW | 347.1 | 281.5 | 273.6 | 216.9 | 341.9 | 259.1 |
| Gaines | 348.3 | 274.8 | 271.1 | 189.9 | 336.5 | 247.4 |
| SRW | 348.8 | 269.0 | 272.0 | 169.5 | 339.0 | 252.6 |

Table 8. Break sizings (percent of wheat).

| | Wheat | | | | |
|---|---|---|---|---|---|
| Break | HRS-H | HRS-L | HRW | Gaines | SRW |
| 1 Bk. (-18TT +38GG) | 20.1 | 18.3 | 20.0 | 18.7 | 15.2 |
| 2 Bk. (-18TT +38GG) | 15.4 | 14.6 | 13.2 | 10.6 | 9.1 |
| 3 Bk. (-22TT +56GG) | 11.0 | 9.7 | 8.7 | 7.0 | 8.0 |
| TOTALS | 46.5 | 42.6 | 41.9 | 36.3 | 32.3 |

The quantity of sizings produced seems to be indicative of the relative ease of sifting. Ground stock from wheats which produce relatively large quantities of sizings (hard wheats) sifts more easily than stock from wheat which does not produce much sizings (soft wheat).

Tables 10, 11, 12, 13, and 14 were prepared as a check on the stream weights recorded during the sampling of the mill streams. The lines read horizontally indicate the loads as weighed leaving the section indicated on the left. The vertical columns indicate the loads which should be flowing to the section indicated at the top of the column.

Such tables are very useful in the design of a new flow to check against the existence of any "run arounds" of stock. The systems are

Table 9. Modulus of uniformity of break stocks (% of stock from sifters/10).

| Wheat | 1 Bk +18 TT | 1 Bk -18 TT +38 CG | 1 Bk -38 GG | 2 Bk +18 TT | 2 Bk -18 TT +38 CG | 2 Bk -38 GG | 3 Bk +22 TT | 3 Bk -22 TT +56 CG | 3 Bk -56 GG | Bk red +54 GG | Bk red -54 GG +9 XX | Bk red -9 XX | 4 Bk +20 TT | 4 Bk -20 TT +8 XX | 4 Bk -8 XX | 5 Bk +20 TT | 5 Bk -20 TT +50 CG | 5 Bk -50 CG |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HRS-E | 7.0 | 2.1 | 1.0 | 6.0 | 2.3 | 1.7 | 6.2 | 2.4 | 1.4 | 4.4 | 3.8 | 1.8 | 7.0 | 1.9 | 1.1 | 6.9 | 1.8 | 1.3 |
| HRS-L | 6.9 | 1.9 | 1.2 | 5.8 | 2.2 | 2.0 | 6.4 | 2.2 | 1.4 | 4.1 | 3.7 | 2.2 | 7.3 | 1.7 | 1.0 | 7.0 | 1.6 | 1.4 |
| HRW | 6.8 | 2.0 | 1.2 | 6.1 | 2.0 | 1.9 | 6.0 | 2.2 | 1.8 | 4.2 | 3.8 | 2.0 | 7.5 | 1.6 | 0.9 | 7.5 | 1.6 | 0.9 |
| Gaines | 6.9 | 1.9 | 1.2 | 6.1 | 1.6 | 2.3 | 6.0 | 1.7 | 2.3 | 3.7 | 3.5 | 2.8 | 7.4 | 1.4 | 1.2 | 7.0 | 1.7 | 1.3 |
| SLW | 7.1 | 1.5 | 1.4 | 5.9 | 1.3 | 2.8 | 5.9 | 1.8 | 2.3 | 3.1 | 3.1 | 3.8 | 7.4 | 1.5 | 1.1 | 7.1 | 1.8 | 1.1 |

Table 10. HARD RED SPRING LOW PROTEIN, FLOW RATES, % OF WHEAT, KANSAS STATE UNIVERSITY PILOT FLOUR MILL

| | 1 Bk | 2 Bk | P-1 | 3 Bk | 1,2,3 Red | P-2 | P-3 | P-4 | C.Siz | P-5 | F.Siz | 1M | P-6 | 2M | 2Q | 4 Bk | P-7 | 3M | 1T | 4M | Suc | 5 Bk | 5M | B.D. | S.D. | B.& S.D. | 6M | Flour | Feed | Load From | Load To |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Pre Bk | 93.8 | | .5 | | .6 | | | | | | | | | | | | | | | | | | | | | | | .1 | | 100.0 | |
| 1 Bk | | 65.8 | 13.3 | | 8.4 | | | | | | | | | | | | | | | | | | | | | | | 2.5 | | 97.0 | 93.8 |
| 2 Bk | | | 14.6 | 33.9 | 9.5 | | | | | | | | | | | | | | | | | | | | | | | 3.7 | | 66.7 | 65.8 |
| P-1 | | | | 4.8 | | | | | 21.5 | | 8.5 | | | | | | | | | | | .1 | | | | | | | | 34.9 | 33.4 |
| 3 Bk | | | | | 3.5 | | | 9.7 | | | | | | | | 27.8 | | | | | | | | | | | | 2.3 | | 43.8 | 43.7 |
| 1,2,3 Red | | | | | | 9.2 | 8.4 | | | | | | | 3.2 | | | | | | | | | | | | | | 1.7 | | 22.5 | 21.9 |
| P-2 | | | | | | | | | .4 | | 5.9 | 2.3 | | | | | | | .2 | | | .1 | | | | | | | | 8.9 | 9.2 |
| P-3 | | | | | | | | | | | 0.0 | 4.9 | | 2.0 | 1.3 | | | | .2 | | | | | | | | | | | 8.4 | 8.4 |
| P-4 | | | | | | | | | | | 5.3 | 0.0 | | | 2.3 | | | | 1.5 | | | | | | | | | | | 9.1 | 9.7 |
| C.Siz | | | | | | | | | | 17.1 | | 1.0 | | | | | | | .9 | | | | | | | | | 1.6 | | 20.6 | 22.0 |
| P-5 | | | | | | | | | | | 2.1 | 15.2 | | 0.0 | .2 | | | | .2 | | | | | | | | | | | 17.7 | 17.1 |
| F.Siz | | | | | | | | | | | | 5.4 | 11.7 | | | | | | .6 | | | | | | | | | 3.3 | | 21.0 | 21.8 |
| 1M | | | | | | | | | | | | | 2.9 | 11.6 | | | | | .1 | | | | | | | | | 12.6 | | 27.2 | 28.8 |
| P-6 | | | | | | | | | | | | | | 12.4 | 1.5 | | | | TR | | | | | | | | | | | 13.9 | 14.6 |
| 2M | | | | | | | | | | | | | | | | | 3.3 | 12.7 | .1 | | | | | | | | | 13.1 | | 29.2 | 29.2 |
| 2Q | | | | | | | | | | | | | | | | | 2.5 | 1.1 | .8 | | | | | | | | | .8 | | 5.2 | 5.3 |
| 4 Bk | | | | | | | | | | | | | | | | | 2.7 | | | 1.2 | | 21.5 | | | | | | 1.5 | | 26.9 | 27.8 |
| P-7 | | | | | | | | | | | | | | | | | | 3.8 | 2.7 | | | .2 | | | | | | | | 6.7 | 8.5 |
| 3M | | | | | | | | | | | | | | | | | | | 1.2 | 7.5 | | | | | | | | 10.1 | | 18.8 | 17.6 |
| 1T | | | | | | | | | | | | | | | | | | | | 2.0 | | | 2.0 | | | | | .6 | 3.4 | 8.0 | 8.5 |
| 4M | | | | | | | | | | | | | | | | | | | | | | TR | 3.7 | | | | | 6.7 | | 10.4 | 10.7 |
| Suc | | | | | | | | | | | | | | | | | | | | | | .3 | .4 | | | | | .3 | | 1.0 | * |
| 5 Bk | | | | | | | | | | | | | | | | | | | | | | | 1.7 | 16.4 | 3.7 | | | 1.7 | | 23.5 | 22.0 |
| 5M | | | | | | | | | | | | | | | | | | | | | | | | | .9 | | 1.5 | 3.6 | | 6.0 | 7.8 |
| B.D. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | * | 16.4 |
| S.D. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | * | 4.6 |
| B.&S.D. | | | | | | | | | | | | | | | | | | | | | | | | | | | 1.1 | 2.2 | 1.8 | 5.1 | * |
| 6M | | | | | | | | | | | | | | | | | | | | | | | | | | | | 1.6 | 1.9 | 3.5 | 2.6 |
| | 93.8 | 65.8 | 33.4 | 43.7 | 22.0 | 9.2 | 8.4 | 9.7 | 21.9 | 17.1 | 21.8 | 23.8 | 14.6 | 29.2 | 5.3 | 27.8 | 8.5 | 17.6 | 8.5 | 10.7 | * | 22.0 | 7.8 | 16.4 | 4.6 | * | 2.6 | | | | |

*Stream not weighed.

Table 11. HARD RED SPRING HIGH PROTEIN, FLOW RATES, % OF WHEAT, KANSAS STATE UNIVERSITY PILOT FLOUR MILL

| | 1 Bk | 2 Bk | P-1 | 3 Bk | 1,2,3 Red | P-2 | P-3 | P-4 | C.Siz | P-5 | F.Siz | 1M | P-6 | 2M | 2Q | 4 Bk | P-7 | 3M | 1T | 4M | Suc | 5 Bk | 5M | B.D. | S.D. | 3,4 S.D. | 6M | Flour | Feed | Load From | Load To |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Pre Bk | 99.4 | | .3 | | .2 | | | | | | | | | | | | | | | | | | | | | | | .1 | | 100.0 | |
| 1 Bk | | 67.7 | 20.1 | | 7.5 | | | | | | | | | | | | | | | | | | | | | | | 1.7 | | 97.0 | 99.4 |
| 2 Bk | | | 15.4 | 41.0 | 9.0 | | | | | | | | | | | | | | | | | | | | | | | 2.5 | | 67.9 | 67.7 |
| P-1 | | | | 5.2 | | | | | 23.2 | | 8.2 | | | | | | | | | | | .1 | | | | | | | | 35.6 | 35.8 |
| 3 Bk | | | | | 3.9 | | | 11.0 | | | | | | | | 28.0 | | | | | | | | | | | | 2.4 | | 45.3 | 45.1 |
| 1,2,3,Bk Red | | | | | | 9.3 | 7.9 | | | | | | | 2.7 | | | | | | | | | | | | | | 1.2 | | 21.1 | 20.6 |
| P-2 | | | | | | | | | .3 | | 4.8 | 3.9 | | | | | | | .1 | | | TR | | | | | | | | 9.1 | 9.3 |
| P-3 | | | | | | | | | | | 0.0 | 4.0 | | 2.9 | .6 | | | | .1 | | | | | | | | | | | 7.5 | 7.7 |
| P-4 | | | | | | | | | | | 5.7 | 0.0 | | | 2.2 | | | | 1.8 | | | | | | | | | | | 9.7 | 11.0 |
| C.Siz | | | | | | | | | | 19.2 | | .8 | | | | | | | .9 | | | | | | | | | 1.5 | | 22.4 | 23.5 |
| P-5 | | | | | | | | | | | 3.3 | 14.9 | | 0.0 | .4 | | | | .3 | | | | | | | | | | | 18.9 | 19.2 |
| F.Siz | | | | | | | | | | | | 5.6 | 11.1 | | | | | | .8 | | | | | | | | | 3.6 | | 21.1 | 22.0 |
| 1M | | | | | | | | | | | | | 3.2 | 14.3 | | | | | TR | | | | | | | | | 11.4 | | [illegible] | 29.2 |
| P-6 | | | | | | | | | | | | | | 11.9 | 1.9 | | | | TR | | | | | | | | | | | [illegible] | 14.3 |
| 2M | | | | | | | | | | | | | | | | | 3.2 | 13.4 | .1 | | | | | | | | | 15.7 | | 32.3 | 31.8 |
| 2Q | | | | | | | | | | | | | | | | | 2.8 | .9 | 1.0 | | | | | | | | | .5 | | 5.2 | 5.1 |
| 4 Bk | | | | | | | | | | | | | | | | | 3.1 | | | 1.1 | | 20.8 | | | | | | 1.5 | | 26.5 | 28.0 |
| P-7 | | | | | | | | | | | | | | | | | | 4.6 | 3.9 | | | .3 | | | | | | | | 8.8 | 9.1 |
| 3M | | | | | | | | | | | | | | | | | | | 1.3 | 4.9 | | | | | | | | 12.2 | | 13.4 | 18.9 |
| 1T | | | | | | | | | | | | | | | | | | | | 2.0 | | | 2.4 | | | | | .7 | 3.9 | 9.0 | 10.3 |
| 4M | | | | | | | | | | | | | | | | | | | | | | .1 | 3.5 | | | | | 7.1 | | 10.7 | 8.0 |
| Suc | | | | | | | | | | | | | | | | | | | | | | .5 | .4 | | | | | .2 | | 1.1 | * |
| 5 Bk | | | | | | | | | | | | | | | | | | | | | | | 1.4 | 15.9 | 4.1 | | | 1.5 | | 22.9 | 21.8 |
| 5M | | | | | | | | | | | | | | | | | | | | | | | | | 1.1 | | 1.0 | 2.5 | | 4.6 | 7.7 |
| B.D. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | * | 15.9 |
| S.D. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | * | 5.2 |
| 3,4 S.D. | | | | | | | | | | | | | | | | | | | | | | | | | | | [illegible] | 2.7 | 2.5 | [illegible] | * |
| 6M | | | | | | | | | | | | | | | | | | | | | | | | | | | | 2.2 | 1.5 | 4.3 | [illegible] |
| | 99.4 | 67.7 | 35.5 | 45.1 | 20.6 | 9.3 | 7.9 | 11.0 | 23.5 | 19.2 | 22.0 | 29.2 | 14.3 | 31.8 | 5.1 | 28.0 | 9.1 | 18.9 | 10.3 | 8.0 | * | 21.8 | 7.7 | 15.9 | 5.2 | * | 2.9 | | | | |

*Stream not weighed.

## Table 12. H.R.W., TEST 3, FLOW RATES, % OF WHEAT, KANSAS STATE UNIVERSITY PILOT FLOUR MILL

| | 1 Bk | 2 Bk | P-1 | 3 Bk | 1,2,3 Red | P-2 | P-3 | P-4 | C.Siz | P-5 | F.Siz | 1M | P-6 | 2M | 2Q | 4 Bk | P-7 | 3M | 1T | 4M | Suc | 5 Bk | 5 M | B.D. | S.D. | B.& S.D. | 6M | Flour | Feed | Load From | Load To |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bra Bk | 98.7 | | .5 | | .5 | | | | | | | | | | | | | | | | | | | | | | | .2 | | 100.0 | |
| 1 Bk | | 66.3 | 20.0 | | 8.4 | | | | | | | | | | | | | | | | | | | | | | | 2.9 | | 97.6 | 98.7 |
| 2 Bk | | | 13.2 | 39.2 | 8.6 | | | | | | | | | | | | | | | | | | | | | | | 3.3 | | 64.3 | 66.3 |
| P-1 | | | | 3.0 | | | | | 23.5 | | 7.0 | | | | | | | | | | | TR | | | | | | | | 33.5 | 33.7 |
| 3 Bk | | | | | 3.7 | | | 8.7 | | | | | | | | 24.1 | | | | | | | | | | | | 3.4 | | 39.9 | 42.2 |
| 1,2,3 Bk Red | | | | | | 8.8 | 8.0 | | | | | | | 3.4 | | | | | | | | | | | | | | .9 | | 21.1 | 21.2 |
| P-2 | | | | | | | | | TR | | 3.5 | 5.1 | | | | | | | 0.0 | | | 0.0 | | | | | | | | 8.6 | 8.8 |
| P-3 | | | | | | | | | | | 0.0 | 6.6 | | 1.1 | TR | | | | TR | | | | | | | | | | | 7.7 | 8.0 |
| P-4 | | | | | | | | | | | 6.6 | 0.0 | | | 1.2 | | | | 1.2 | | | | | | | | | | | 9.0 | 8.7 |
| C.Siz | | | | | | | | | | 19.7 | | .6 | | | | | | | .9 | | | | | | | | | 1.4 | | 22.6 | 23.5 |
| P-5 | | | | | | | | | | | 5.8 | 10.6 | | 0.0 | 1.5 | | | | .5 | | | | | | | | | | | 18.4 | 19.7 |
| F.Siz | | | | | | | | | | | | 6.0 | 11.8 | | | | | | 1.2 | | | | | | | | | 3.2 | | 22.2 | 22.9 |
| 1M | | | | | | | | | | | | | 2.3 | 12.4 | | | | | TR | | | | | | | | | 13.3 | | 28.0 | 23.9 |
| P-6 | | | | | | | | | | | | | | 11.2 | 1.3 | | | | .3 | | | | | | | | | | | 13.8 | 14.1 |
| 2M | | | | | | | | | | | | | | | | | 1.8 | 12.3 | TR | | | | | | | | | 14.0 | | 28.1 | 23.1 |
| 2Q | | | | | | | | | | | | | | | | | 3.8 | .5 | .8 | | | | | | | | | .4 | | 5.5 | 4.0 |
| 4 Bk | | | | | | | | | | | | | | | | | 2.3 | | | 1.1 | | 20.9 | | | | | | 1.3 | | 25.6 | 24.1 |
| P-7 | | | | | | | | | | | | | | | | | | 4.2 | 6.2 | | | .3 | | | | | | | | 10.7 | 7.9 |
| 3M | | | | | | | | | | | | | | | | | | | .4 | 5.1 | | | | | | | | 10.1 | | 15.6 | 17.0 |
| 1T | | | | | | | | | | | | | | | | | | | | 3.3 | | | 2.9 | | | | | .6 | 3.4 | 10.2 | 11.5 |
| 4M | | | | | | | | | | | | | | | | | | | | | | TR | 3.7 | | | | | 6.3 | | 10.0 | 9.5 |
| Suc | | | | | | | | | | | | | | | | | | | | | | .3 | .4 | | | | | .5 | | 1.2 | * |
| 5 Bk | | | | | | | | | | | | | | | | | | | | | | | .6 | 15.9 | 3.3 | | | 1.4 | | 21.2 | 21.5 |
| 5M | | | | | | | | | | | | | | | | | | | | | | | | | 1.1 | | 1.0 | 2.2 | | 4.3 | 7.6 |
| B.D. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | * | 15.9 |
| S.D. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | * | 4.4 |
| B.&S.D. | | | | | | | | | | | | | | | | | | | | | | | | | | | .9 | 1.9 | 1.6 | 4.4 | * |
| 6M | | | | | | | | | | | | | | | | | | | | | | | | | | | | .9 | 1.1 | 2.0 | 1.9 |
| | 98.7 | 66.3 | 33.7 | 42.2 | 21.2 | 8.8 | 8.0 | 8.7 | 23.5 | 19.7 | 22.9 | 23.9 | 14.1 | 23.1 | 4.0 | 24.1 | 7.9 | 17.0 | 11.5 | 9.5 | * | 21.5 | 7.6 | 15.9 | 4.4 | * | 1.9 | | | | |

*Stream not weighed.

Table 13. SALNES, FLOW RATES, % OF WHEAT, KANSAS STATE UNIVERSITY PILOT FLOUR MILL

| | 1 Bk | 2 Bk | P-1 | 3 Bk | 1,2,3 Red | P-2 | P-3 | P-4 | C.Siz | P-5 | F.Siz | 1M | P-6 | 2M | 2Q | 4 Bk | P-7 | 3M | 1T | 4M | Suc | 5 Bk | 5M | B.D. | S.D. | B.& S.D. | 6M | Flour | Feed | Load From | Load To |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Pre Bk | 98.1 | | 1.0 | | .7 | | | | | | | | | | | | | | | | | | | | | | | .2 | | 100.0 | |
| 1 Bk | | 66.5 | 18.7 | | 9.5 | | | | | | | | | | | | | | | | | | | | | | | 2.3 | | 97.0 | 98.1 |
| 2 Bk | | | 10.6 | 43.3 | 10.8 | | | | | | | | | | | | | | | | | | | | | | | 4.6 | | 65.3 | 66.5 |
| P-1 | | | | 2.2 | | | | | 18.5 | | 8.3 | | | | | | | | | | | TR | | | | | | | | 30.0 | 30.3 |
| 3 Bk | | | | | 6.1 | | | 7.0 | | | | | | | | 25.2 | | | | | | | | | | | | 3.5 | | 41.8 | 43.5 |
| 1,2,3 Bk Red | | | | | | 10.2 | 9.6 | | | | | | | 2.4 | | | | | | | | | | | | | | 5.3 | | 27.5 | 27.1 |
| P-2 | | | | | | | | | .3 | | 6.1 | 3.0 | | | | | | | .3 | | | TR | | | | | | | | 9.7 | 10.2 |
| P-3 | | | | | | | | | | | 0.0 | 5.2 | | 2.7 | 1.3 | | | | .1 | | | | | | | | | | | 9.3 | 9.6 |
| P-4 | | | | | | | | | | | 2.4 | 0.0 | | | 2.4 | | | | 1.5 | | | | | | | | | | | 6.3 | 7.0 |
| C.Siz | | | | | | | | | | 15.4 | | .7 | | | | | | | .9 | | | | | | | | | 1.5 | | 18.5 | 18.8 |
| P-5 | | | | | | | | | | | 2.5 | 14.3 | | 0.0 | .2 | | | | .1 | | | | | | | | | | | 17.1 | 15.4 |
| F.Siz | | | | | | | | | | | | 4.5 | 10.2 | | | | | | .8 | | | | | | | | | 3.3 | | 13.8 | 19.3 |
| 1M | | | | | | | | | | | | | 2.4 | 12.4 | | | | | .2 | | | | | | | | | 13.8 | | 28.8 | 27.7 |
| P-6 | | | | | | | | | | | | | | 11.1 | 1.0 | | | | TR | | | | | | | | | | | 12.0 | 12.5 |
| 2M | | | | | | | | | | | | | | | | | 3.5 | 11.7 | .1 | | | | | | | | | 12.6 | | 27.9 | 28.6 |
| 2Q | | | | | | | | | | | | | | | | | 2.3 | .5 | 1.2 | | | | | | | | | .4 | | 4.4 | 4.9 |
| 4 Bk | | | | | | | | | | | | | | | | | 1.7 | | | 1.1 | | 19.3 | | | | | | 1.7 | | 23.3 | 25.2 |
| P-7 | | | | | | | | | | | | | | | | | | 1.2 | 6.2 | | | .5 | | | | | | | | 7.9 | 7.5 |
| 3M | | | | | | | | | | | | | | | | | | | 1.1 | 4.3 | | | | | | | | 9.7 | | 15.1 | 13.4 |
| 1T | | | | | | | | | | | | | | | | | | | | 3.0 | | | 4.3 | | | | | .6 | 4.4 | 12.3 | 12.5 |
| 4M | | | | | | | | | | | | | | | | | | | | | | TR | 1.4 | | | | | 5.0 | | 6.4 | 8.4 |
| Suc | | | | | | | | | | | | | | | | | | | | | | .4 | 1.0 | | | | | .3 | | 1.7 | * |
| 5 Bk | | | | | | | | | | | | | | | | | | | | | | | .7 | 14.2 | 3.5 | | | 1.9 | | 20.3 | 20.3 |
| 5M | | | | | | | | | | | | | | | | | | | | | | | | | 1.2 | | 2.5 | 1.9 | | 5.5 | 7.4 |
| B.D. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | * | 14.2 |
| S.D. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | * | 4.7 |
| B.&S.D. | | | | | | | | | | | | | | | | | | | | | | | | | | | .5 | 2.9 | 1.2 | 4.7 | * |
| 6M | | | | | | | | | | | | | | | | | | | | | | | | | | | | 4.8 | 6.6 | 11.4 | 3.1 |
| | 98.1 | 66.5 | 30.3 | 43.5 | 27.1 | 10.2 | 9.6 | 7.0 | 18.8 | 15.4 | 19.3 | 27.7 | 12.6 | 28.6 | 4.9 | 25.2 | 7.5 | 13.4 | 12.5 | 8.4 | * | 20.3 | 7.4 | 14.2 | 4.7 | * | 3.1 | | | | |

*Stream not weighed.

Table 14. S.R.W., FLOW RATES, % OF WHEAT, KANSAS STATE UNIVERSITY PILOT FLOUR MILL

| | 1 Bk | 2 Bk | B-1 | 3 Bk | 1,2,3 Red | B-2 | B-3 | B-4 | C.Siz | B-5 | F.Siz | 1M | B-6 | 2M | 2Q | 4 Bk | B-7 | 3M | 1T | 4M | Suc | 5 Bk | 5M | B.D. | S.D. | B.& S.D. | 6M | Flour | Feed | Load From | Load To |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Pre Bk | 99.1 | | .3 | | .5 | | | | | | | | | | | | | | | | | | | | | | | .1 | | 100.0 | |
| 1 Bk | | 69.5 | 15.2 | | 11.2 | | | | | | | | | | | | | | | | | | | | | | | 2.0 | | 97.9 | 99.1 |
| 2 Bk | | | 9.1 | 41.2 | 14.4 | | | | | | | | | | | | | | | | | | | | | | | 5.1 | | 69.6 | 69.5 |
| B-1 | | | | 3.6 | | | | | 13.9 | | 6.9 | | | | | | | | | | | .1 | | | | | | | | 24.5 | 24.6 |
| 3 Bk | | | | | 6.3 | | | 8.0 | | | | | | | | 26.3 | | | | | | | | | | | | 3.7 | | 44.3 | 44.8 |
| 1,2,3 Bk Red | | | | | | 10.0 | 10.0 | | | | | | | 4.9 | | | | | | | | | | | | | | 7.5 | | 32.4 | 32.4 |
| B-2 | | | | | | | | | .4 | | 6.6 | 2.3 | | | | | | | .2 | | | .4 | | | | | | | | 9.9 | 10.0 |
| B-3 | | | | | | | | | | | 0.0 | 3.3 | | 7.5 | .1 | | | | .0 | | | | | | | | | | | 10.9 | 10.0 |
| B-4 | | | | | | | | | | | 2.4 | 0.0 | | | 4.4 | | | | .7 | | | | | | | | | | | 7.5 | 8.0 |
| C.Siz | | | | | | | | | | 11.6 | | .2 | | | | | | | 1.0 | | | | | | | | | 1.0 | | 13.3 | 14.3 |
| B-5 | | | | | | | | | | | 2.7 | 3.5 | | 0.0 | .3 | | | | .1 | | | | | | | | | | | 11.6 | 11.5 |
| F.Siz | | | | | | | | | | | | 5.6 | 7.3 | | | | | | .9 | | | | | | | | | 4.3 | | 13.1 | 13.6 |
| 1M | | | | | | | | | | | | | 2.2 | 7.5 | | | | | .2 | | | | | | | | | 7.0 | | 16.9 | 19.9 |
| B-6 | | | | | | | | | | | | | | *7.0 | 5.8 | | | | TR | | | | | | | | | | | 12.3 | 9.5 |
| 2M | | | | | | | | | | | | | | | | | 7.0 | 13.3 | .2 | | | | | | | | | 9.6 | | 30.1 | 26.9 |
| 2Q | | | | | | | | | | | | | | | | | 4.3 | .6 | 4.6 | | | | | | | | | 1.0 | | 10.5 | 10.6 |
| 4 Bk | | | | | | | | | | | | | | | | | 1.8 | | | 1.0 | | 20.1 | | | | | | 1.6 | | 24.5 | 26.3 |
| B-7 | | | | | | | | | | | | | | | | | | 1.3 | 6.5 | | | 1.3 | | | | | | | | 9.1 | 13.1 |
| 3M | | | | | | | | | | | | | | | | | | | .5 | 8.5 | | | | | | | | 7.7 | | 16.7 | 15.2 |
| 1T | | | | | | | | | | | | | | | | | | | | 3.1 | | | 3.8 | | | | | 1.0 | 4.0 | 11.9 | 14.9 |
| 4M | | | | | | | | | | | | | | | | | | | | | | TR | 10.2 | | | | | 4.6 | | 14.8 | 12.6 |
| Suc. | | | | | | | | | | | | | | | | | | | | | | .7 | 1.1 | | | | | .5 | | 2.3 | * |
| 5 Bk | | | | | | | | | | | | | | | | | | | | | | | 1.0 | 15.6 | 3.9 | | | 1.5 | | 23.0 | 22.6 |
| 5M | | | | | | | | | | | | | | | | | | | | | | | | | 2.1 | | 4.9 | 3.5 | | 10.5 | 16.1 |
| B.D. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | * | 15.6 |
| S.D. | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | * | 6.0 |
| B.&S.D | | | | | | | | | | | | | | | | | | | | | | | | | | | 1.9 | 3.0 | 2.9 | 7.8 | * |
| 6M | | | | | | | | | | | | | | | | | | | | | | | | | | | | 3.9 | 5.4 | 9.3 | 6.8 |
| | 99.1 | 69.5 | 24.6 | 44.8 | 32.4 | 10.0 | 10.0 | 8.0 | 14.3 | 11.5 | 13.5 | 19.9 | 9.5 | 26.9 | 10.6 | 25.3 | 13.1 | 15.2 | 14.9 | 12.6 | * | 22.6 | 16.1 | 15.6 | 6.0 | * | 6.8 | | | | |

*Stream not weighed.

arranged from head to tail of the mill going down the page and also from left to right across the page. In this way any entry below the heavy diagonal line must be going to a section which is ahead (in the line of flow) of the one from which it came. This is undesirable since the same stock must be "run around" in that cycle until it is reduced sufficiently to pass through a finer sieve and get out of the loop. All the time there may be a cumulative build-up of the quantity of stock sent to the head of the "run around." This often would mean the reduction in size of some branny (high ash) material, which is contrary to the object of the milling process.

The Tables 10, 11, 12, 13 and 14 are in percent of the wheat sent to the mill. Thus they give a quick check on the balance of the mill in one weigh-up as compared to another.

Flour production data from 14 weigh-ups on six hard red winter wheats is given in Appendix C. From this data the mean and the standard deviation from the mean of flour production of each stream were computed (Table 15). The flour stream weights from any single wheat were fairly constant from one sampling to the next. But from one wheat to another the variation in the flour stream weights increased considerably as shown by the deviations from the means (Table 15).

Using these mean flour weights, a reasonable comparison of total break and duster flour produced was possible (Table 16). This comparison again points out the previously noted fact that the break adjustment was off during the HRS-H milling. Also the greatly increased break flour production (Gaines was 28% and SIW was 46% greater than the mean for HRW)

Table 15. Mean individual flour stream weights.

| Flour stream | Mean stream wt. % T.P. | Standard deviation from mean |
|---|---|---|
| Pre Bk | .131 | .080 |
| 1 Bk | 2.422 | .271 |
| 2 Bk | 3.869 | .465 |
| 3 Bk | 3.739 | .298 |
| 1,2,3 Red | 2.178 | .476 |
| C Siz T | 1.849 | .395 |
| C Siz B | .108 | .032 |
| F Siz T | 2.959 | 1.233 |
| F Siz B | .340 | .287 |
| 1 Mids T | 8.318 | 1.722 |
| 1 Mids B | 3.914 | .893 |
| 2 Mids T | 11.480 | 1.521 |
| 2 Mids B | 3.123 | .413 |
| 2 Qual | .693 | .159 |
| 4 Bk | 1.492 | .185 |
| 3 Mids | 10.031 | 1.603 |
| 1 Tails | .818 | .182 |
| 4 Mids | 6.473 | 1.108 |
| Suction | .330 | .116 |
| 5 Bk | 1.501 | .263 |
| 5 Mids | 4.162 | .758 |
| B and SD | 2.475 | .271 |
| 6 Mids | 2.304 | .286 |

Table 16. Break flour produced.

| | Percent of total products | | | | |
|---|---|---|---|---|---|
| Stream | HRW mean | HRS-L | HRS-H | Gaines | SRW |
| P-Bk | .13 | .15 | .05 | .18 | .09 |
| 1 Bk | 2.42 | 2.74 | 1.77 | 2.38 | 2.19 |
| 2 Bk | 3.87 | 4.11 | 2.60 | 4.75 | 5.42 |
| 3 Bk | 3.74 | 3.26 | 2.44 | 3.47 | 3.82 |
| Bk red. | 2.18 | 1.67 | 1.26 | 5.50 | 7.64 |
| 4 Bk | 1.40 | 1.83 | 1.57 | 1.32 | 1.56 |
| 5 Bk | 1.50 | 1.89 | 1.60 | 1.98 | 1.75 |
| B&SD | 2.48 | 2.45 | 2.85 | 3.15 | 3.34 |
| TOTAL | 17.72 | 18.20 | 14.14 | 22.73 | 25.81 |

in soft wheat milling was due mainly to increased flour made by the first three breaks and not from the clean-up breaks (fourth and fifth breaks) (35).

The relative quantities of flour, bran, shorts, red dog and germ for each wheat milled are given in Table 17. Extensive physical and chemical analysis of each mill feed have been published (11, 43).

## SUMMARY

The data collected during this study gave an indication of the differences and similarities of the distribution of stock produced when milling wheats from four different classes (HRW, HRS, SRW, and Western White). The data showed the similarity of the milling characteristics of the HRS wheats and those of HRW wheat. Though the granulation of the break stocks from the HRS wheats was coarser than those from the HRW wheats, the sifting characteristics appeared to be quite similar. All through the mill the soft wheats (both SRW and the Western White) were quite different from the hard wheats. The soft wheats produced much more fine break stock than any of the hard wheats and the ground soft wheat sifted more slowly than those from the hard wheats.

The break granulation curves produced from the streams as weighed flowing from the break sifters indicated that a straight line approximation of the granulation of break stock produced from hard wheats would be satisfactory for flow sheet and mill designing purposes. The second and third break granulation curves of the break stock from the soft wheats were much more concave than the similar curves of hard wheat break stock. This indicates an increased production of fine middlings and flour when

Table 17. Percentages of the products of milling.

| Wheat | HRW-L | HRW-H | HRW-1 | HRW-2 | HRW-3 | HRS-L | HRS-H | Gaines | SRW |
|---|---|---|---|---|---|---|---|---|---|
| | % T.P. | % T.P. | % T.P. | % T.P. | % T.P. | % T.P. | % T.P. | % T.P. | % T.P. |
| Flour | 72.98 | 72.44 | 74.57 | 75.82 | 74.95 | 76.73 | 74.68 | 77.03 | 72.33 |
| Bran | 16.66 | 13.80 | 14.26 | 15.31 | 13.82 | 13.82 | 14.68 | 12.52 | 14.21 |
| Shorts | 6.94 | 8.87 | 7.07 | 6.60 | 7.79 | 6.80 | 7.93 | 7.83 | 8.00 |
| Red Dog | 2.53 | 3.66 | 3.35 | 1.39 | 2.57 | 1.80 | 1.64 | 1.67 | 4.69 |
| Germ | 0.69 | 0.58 | 0.75 | 0.88 | 0.87 | 0.85 | 1.06 | 0.95 | 0.77 |
| Choke | | 0.67[1] | | | | | | | |
| Total feed | 27.02 | 27.58 | 25.43 | 24.18 | 25.05 | 23.27 | 25.31 | 22.97 | 27.67 |
| Total products | 100.00 | 100.02 | 100.00 | 100.00 | 100.00 | 100.00 | 99.99 | 100.00 | 100.00 |

[1]This was 64 pounds of fifth break stock, more like feed than flour, collected following a choke of the fifth break pneumatic lift.

milling soft wheats. The granulation curves of stock flowing from the break reduct sifter show the incomplete sifting of soft wheat break stock in the break sifters. This also indicates that the break granulation curves from the soft wheat millings should have been more concave than they were.

The distribution of stock in the reduction system of the mill for the hard and soft wheats was quite dissimilar. The soft wheats reduced more quickly but sifted more slowly than the hard wheats. This caused the load on the tail of the mill to be high and the tail end ash to be lower during the soft wheat milling than during the hard wheat milling. The HRS wheat showed some tendency to be more difficult to reduce than the HRW wheat but sifted with the same ease as HRW.

The weigh-ups of individual flour streams during the millings of the HRW wheats showed that individual stream weights remained fairly constant during the milling of a given wheat. Between wheats (only one wheat was milled on any day) there was somewhat greater difference in individual stream weights.

## SUGGESTIONS FOR FUTURE WORK

The data acquired during this study represent a base to build on and add to in the acquisition of knowledge which will be required before a flour mill is finally automated. Future studies on the same mill could investigate the feasibility of adjusting the milling machinery based on the mean individual flour stream weights presented in the present study. The flour produced during each grinding operation seems a likely basis for controlling a flour mill since flour production is common to every grinding and sifting operation in a mill, purification excluded.

A series of granulation curves obtained from different roll settings of the same pair of rolls grinding the same stock could give some insight as to the portion of the ground stock which would best reflect the performance of the given set of rolls. This would be of interest in studying the control of a flour mill by sensing the rate of flour production.

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# APPENDICES

## APPENDIX A

STREAM WEIGHTS AND ANALYSES OF ALL THE STREAMS IN THE K.S.U. LARGE FLOUR MILL

| STREAM NAME | POUNDS PER HOUR | PERCENT OF SYSTEM | CUMULATIVE PERCENT SYSTEM | PERCENT OF WHEAT | CUMULATIVE PERCENT WHEAT | ASH | PROTEIN | MOISTURE |
|---|---|---|---|---|---|---|---|---|
| **** P BK | HRS-L **** | | | | | | | |
| +24TT 1 BK | 1071.0 | 98.76 | 98.76 | 98.76 | 98.76 | 1.51 | 11.14 | 14.3 |
| +38GG P-1 | 5.0 | .46 | 99.22 | .46 | 99.22 | .82 | 9.82 | 14.2 |
| +70GG B-RD | 4.0 | .37 | 99.59 | .37 | 99.59 | .45 | 8.75 | 14.5 |
| +12XX B RD | 3.0 | .28 | 99.86 | .28 | 99.86 | .37 | 8.27 | 14.7 |
| -12XX FL | 1.5 | .14 | 100.00 | .14 | 100.00 | .37 | 9.47 | 14.6 |
| **** P BK | HRS-H **** | | | | | | | |
| +24TT 1 BK | 1055.0 | 99.37 | 99.37 | 99.37 | 99.37 | 1.52 | 13.72 | 15.4 |
| +38GG P-1 | 3.5 | .33 | 99.70 | .33 | 99.70 | 1.19 | 13.09 | 13.3 |
| +70GG B-RD | 2.4 | .23 | 99.92 | .23 | 99.92 | .76 | 11.80 | 13.3 |
| +12XX B RD | .3 | .03 | 99.95 | .03 | 99.95 | .94 | 10.28 | 11.3 |
| -12XX FL | .5 | .05 | 100.00 | .05 | 100.00 | .62 | 13.02 | 14.1 |
| **** P BK | GAINES **** | | | | | | | |
| +24TT 1 BK | 859.0 | 98.13 | 98.13 | 98.13 | 98.13 | 1.19 | 9.66 | 13.6 |
| +38GG P-1 | 8.5 | .97 | 99.10 | .97 | 99.10 | .78 | 9.24 | 13.4 |
| +70GG B RD | 4.7 | .54 | 99.63 | .54 | 99.63 | .46 | 7.50 | 12.8 |
| +12XX B RD | 1.6 | .18 | 99.82 | .18 | 99.82 | .41 | 7.42 | 13.1 |
| -12XX FL | 1.6 | .18 | 100.00 | .18 | 100.00 | .45 | 6.52 | 14.2 |
| **** P BK | SRW **** | | | | | | | |
| +24TT 1 BK | 944.0 | 99.13 | 99.13 | 99.13 | 99.13 | 1.62 | 12.03 | 14.9 |
| +38GG P-1 | 2.5 | .26 | 99.39 | .26 | 99.39 | .49 | 8.94 | 14.4 |
| +70GG B RD | 2.0 | .21 | 99.60 | .21 | 99.60 | .36 | 9.20 | 14.0 |
| +12XX B RD | 3.0 | .32 | 99.92 | .32 | 99.92 | .45 | 9.73 | 13.4 |
| -12XX FL | .8 | .08 | 100.00 | .08 | 100.00 | .40 | 9.26 | 14.6 |
| **** P BK | HRW **** | | | | | | | |
| +24TT 1 BK | 1079.0 | 98.72 | 98.72 | 98.72 | 98.72 | 1.52 | 12.40 | 15.4 |
| +38GG P-1 | 6.0 | .55 | 99.27 | .55 | 99.27 | .52 | 9.89 | 14.8 |
| +70GG B RD | 3.0 | .27 | 99.54 | .27 | 99.54 | .35 | 9.67 | 14.6 |
| +12XX B RD | 3.0 | .27 | 99.82 | .27 | 99.82 | .38 | 8.78 | 13.8 |
| -12XX FL | 2.0 | .18 | 100.00 | .18 | 100.00 | .40 | 9.74 | 13.5 |

| STREAM NAME | POUNDS PER HOUR | PERCENT OF SYSTEM | CUMULATIVE PERCENT SYSTEM | PERCENT OF WHEAT | CUMULATIVE PERCENT WHEAT | ASH | PROTEIN | MOISTURE |
|---|---|---|---|---|---|---|---|---|
| **** 1 BK | HRS-L **** | | | | | | | |
| +18TT 2 BK | 724.0 | 68.79 | 68.79 | 66.76 | 66.76 | 1.90 | 11.70 | 14.0 |
| +38GG P-1 | 199.0 | 18.91 | 87.70 | 18.35 | 85.11 | .60 | 9.92 | 15.0 |
| +70GG B RD | 61.0 | 5.80 | 93.49 | 5.62 | 90.73 | .36 | 8.78 | 15.8 |
| +12XX B RD | 41.5 | 3.94 | 97.43 | 3.83 | 94.56 | .35 | 8.76 | 15.6 |
| -12XX FL | 27.0 | 2.57 | 100.00 | 2.49 | 97.05 | .37 | 10.08 | 15.5 |
| **** 1 BK | HRS-H **** | | | | | | | |
| +18TT 2 BK | 718.4 | 69.77 | 69.77 | 67.67 | 67.67 | 2.09 | 14.43 | 13.6 |
| +38GG P-1 | 213.8 | 20.77 | 90.54 | 20.14 | 87.80 | .65 | 11.43 | 14.2 |
| +70GG B RD | 53.6 | 5.21 | 95.75 | 5.05 | 92.85 | .39 | 11.61 | 14.8 |
| +12XX B RD | 25.8 | 2.51 | 98.25 | 2.43 | 95.28 | .39 | 12.69 | 14.6 |
| -12XX FL | 18.0 | 1.75 | 100.00 | 1.70 | 96.98 | .49 | 14.94 | 14.8 |
| **** 1 BK | GAINES **** | | | | | | | |
| +18TT 2 BK | 582.0 | 68.54 | 68.54 | 66.48 | 66.48 | 1.58 | 10.84 | 12.7 |
| +38GG P-1 | 164.0 | 19.31 | 87.85 | 18.73 | 85.22 | .46 | 7.77 | 13.7 |
| +70GG B RD | 54.4 | 6.41 | 94.25 | 6.21 | 91.43 | .30 | 7.37 | 13.7 |
| +12XX B RD | 29.1 | 3.43 | 97.68 | 3.32 | 94.76 | .30 | 7.79 | 13.9 |
| -12XX FL | 19.7 | 2.32 | 100.00 | 2.25 | 97.01 | .31 | 5.61 | 14.1 |
| **** 1 BK | SRW **** | | | | | | | |
| +18TT 2 BK | 662.0 | 70.95 | 70.95 | 69.52 | 69.52 | 2.29 | 13.44 | 13.6 |
| +38GG P-1 | 145.0 | 15.54 | 86.50 | 15.23 | 84.74 | .52 | 9.88 | 14.7 |
| +70GG B RD | 65.0 | 6.97 | 93.46 | 6.83 | 91.57 | .29 | 9.60 | 14.9 |
| +12XX B RD | 42.0 | 4.50 | 97.96 | 4.41 | 95.98 | .26 | 9.92 | 15.0 |
| -12XX FL | 19.0 | 2.04 | 100.00 | 2.00 | 97.97 | .27 | 6.58 | 15.1 |
| **** 1 BK | HRW **** | | | | | | | |
| +18TT 2 BK | 725.0 | 67.88 | 67.88 | 66.33 | 66.33 | 2.05 | 13.24 | 16.2 |
| +38GG P-1 | 219.0 | 20.51 | 88.39 | 20.04 | 86.37 | .52 | 9.96 | 15.4 |
| +70GG B RD | 59.0 | 5.52 | 93.91 | 5.40 | 91.77 | .37 | 9.56 | 15.4 |
| +12XX B RD | 33.0 | 3.09 | 97.00 | 3.02 | 94.78 | .39 | 10.12 | 15.9 |
| -12XX FL | 32.0 | 3.00 | 100.00 | 2.93 | 97.71 | .40 | 11.09 | 15.5 |

| STREAM NAME | POUNDS PER HOUR | PERCENT OF SYSTEM | CUMULATIVE PERCENT SYSTEM | PERCENT OF WHEAT | CUMULATIVE PERCENT WHEAT | ASH | PROTEIN | MOISTURE |
|---|---|---|---|---|---|---|---|---|
| **** 2 BK | HRS-L **** | | | | | | | |
| +10TT 3 BC | 288.0 | 39.89 | 39.89 | 26.56 | 26.56 | 3.09 | 12.47 | 13.8 |
| +18TT 3 BF | 133.5 | 18.49 | 58.38 | 12.31 | 38.87 | 2.70 | 13.38 | 13.9 |
| +38GG P-1 | 158.0 | 21.88 | 80.26 | 14.57 | 53.43 | .77 | 10.72 | 14.2 |
| +12XX B RD | 102.5 | 14.20 | 94.46 | 9.45 | 62.89 | .31 | 9.91 | 15.8 |
| -12XX FL | 40.0 | 5.54 | 100.00 | 3.69 | 66.57 | .35 | 10.46 | 15.3 |
| **** 2 BK | HRS-H **** | | | | | | | |
| +10TT 3 BC | 295.0 | 40.91 | 40.91 | 27.79 | 27.79 | 3.18 | 15.81 | 13.5 |
| +18TT 3 BF | 140.9 | 19.54 | 60.45 | 13.27 | 41.06 | 2.70 | 15.60 | 14.0 |
| +38GG P-1 | 163.5 | 22.67 | 83.12 | 15.40 | 56.46 | .90 | 12.79 | 14.6 |
| +12XX B RD | 95.2 | 13.20 | 96.33 | 8.97 | 65.42 | .34 | 13.05 | 15.0 |
| -12XX FL | 26.5 | 3.67 | 100.00 | 2.50 | 67.92 | .45 | 12.10 | 14.7 |
| **** 2 BK | GAINES **** | | | | | | | |
| +10TT 3 BC | 258.0 | 44.41 | 44.41 | 29.47 | 29.47 | 2.26 | 12.08 | 12.4 |
| +18TT 3 BF | 94.6 | 16.28 | 60.69 | 10.81 | 40.28 | 2.07 | 12.51 | 12.7 |
| +38GG P-1 | 93.2 | 16.04 | 76.73 | 10.65 | 50.93 | .73 | 9.17 | 11.8 |
| +12XX B RD | 94.5 | 16.27 | 92.99 | 10.80 | 61.72 | .31 | 8.47 | 13.7 |
| -12XX FL | 40.7 | 7.01 | 100.00 | 4.65 | 66.37 | .30 | 6.60 | 14.0 |
| **** 2 BK | SRW **** | | | | | | | |
| +10TT 3 BC | 302.0 | 45.41 | 45.41 | 31.71 | 31.71 | 3.53 | 14.42 | 12.3 |
| +18TT 3 BF | 90.0 | 13.53 | 58.95 | 9.45 | 41.16 | 3.22 | 15.59 | 14.5 |
| +38GG P-1 | 87.0 | 13.08 | 72.03 | 9.14 | 50.30 | .96 | 12.43 | 14.2 |
| +12XX B RD | 137.0 | 20.60 | 92.63 | 14.39 | 64.69 | .28 | 11.35 | 15.1 |
| -12XX FL | 49.0 | 7.37 | 100.00 | 5.15 | 69.83 | .27 | 7.90 | 15.1 |
| **** 2 BK | HRW **** | | | | | | | |
| +10TT 3 BC | 310.0 | 44.10 | 44.10 | 28.36 | 28.36 | 2.95 | 14.74 | 15.4 |
| +18TT 3 BF | 119.0 | 16.93 | 61.02 | 10.89 | 39.25 | 2.75 | 15.06 | 15.5 |
| +38GG P-1 | 144.0 | 20.48 | 81.51 | 13.17 | 52.42 | .76 | 10.89 | 15.5 |
| +12XX B RD | 94.0 | 13.37 | 94.88 | 8.60 | 61.02 | .32 | 10.93 | 15.0 |
| -12XX FL | 36.0 | 5.12 | 100.00 | 3.29 | 64.32 | .39 | 11.69 | 15.4 |

| STREAM NAME | POUNDS PER HOUR | PERCENT OF SYSTEM | CUMULATIVE PERCENT SYSTEM | PERCENT OF WHEAT | CUMULATIVE PERCENT WHEAT | ASH | PROTEIN | MOISTURE |
|---|---|---|---|---|---|---|---|---|
| **** P-1 | HRS-L **** | | | | | | | |
| ASP SUC | 1.6 | .42 | .42 | .15 | .15 | 2.56 | 11.34 | 12.8 |
| +20GG 3 BF | 51.6 | 13.63 | 14.05 | 4.76 | 4.91 | 1.99 | 12.56 | 13.7 |
| +24GG C.S. | 37.8 | 9.98 | 24.03 | 3.49 | 8.39 | 1.11 | 11.97 | 14.5 |
| -24GG C.S. | 196.0 | 51.76 | 75.79 | 18.07 | 26.46 | .44 | 9.89 | 14.8 |
| -32GG F.S. | 91.7 | 24.21 | 100.00 | 8.46 | 34.92 | .31 | 9.78 | 15.6 |
| **** P-1 9 | HRS-H **** | | | | | | | |
| ASP SUC | 1.4 | .36 | .36 | .13 | .13 | 3.53 | 13.84 | 12.4 |
| +20GG 3 BF | 54.4 | 13.98 | 14.34 | 5.12 | 5.26 | 2.06 | 13.92 | 12.3 |
| +24GG C.S. | 46.1 | 11.85 | 26.20 | 4.34 | 9.60 | .96 | 12.19 | 13.2 |
| -24GG C.S. | 200.0 | 51.41 | 77.61 | 18.84 | 28.44 | .50 | 11.53 | 14.2 |
| -32GG F.S. | 87.1 | 22.39 | 100.00 | 8.20 | 36.64 | .30 | 11.91 | 14.8 |
| **** P-1 | GAINES **** | | | | | | | |
| ASP 5 BK | .4 | .15 | .15 | .05 | .05 | 2.41 | 9.06 | 10.8 |
| +20GG 3 BF | 28.0 | 10.66 | 10.81 | 3.20 | 3.24 | 1.67 | 11.51 | 12.6 |
| +24GG C.S. | 30.0 | 11.42 | 22.23 | 3.43 | 6.67 | .87 | 9.79 | 13.9 |
| -24GG C.S. | 131.5 | 50.06 | 72.29 | 15.02 | 21.69 | .51 | 8.17 | 13.7 |
| -32GG F.S. | 72.8 | 27.71 | 100.00 | 8.32 | 30.01 | .31 | 7.61 | 14.1 |
| **** P-1 | SRW **** | | | | | | | |
| ASP 5 BK | 1.1 | .47 | .47 | .12 | .12 | 1.39 | 8.35 | 13.5 |
| +20GG 3 BF | 34.4 | 14.73 | 15.20 | 3.61 | 3.73 | 2.00 | 13.23 | 14.2 |
| +24GG C.S. | 21.0 | 8.99 | 24.20 | 2.21 | 5.93 | 1.20 | 12.34 | 14.3 |
| -24GG C.S. | 111.0 | 47.54 | 71.73 | 11.66 | 17.59 | .61 | 10.32 | 14.2 |
| -32GG F.S. | 66.0 | 28.27 | 100.00 | 6.93 | 24.52 | .28 | 10.60 | 14.8 |
| **** P-1 | HRW **** | | | | | | | |
| ASP 5 BK | .1 | .04 | .04 | .01 | .01 | 2.71 | 9.70 | 11.3 |
| +20GG 3 BF | 33.0 | 8.99 | 9.02 | 3.02 | 3.03 | 2.09 | 13.25 | 13.7 |
| +24GG C.S. | 47.0 | 12.80 | 21.83 | 4.30 | 7.33 | 1.11 | 11.42 | 14.9 |
| -24GG C.S. | 210.0 | 57.20 | 79.03 | 19.21 | 26.54 | .57 | 10.12 | 15.0 |
| -32GG F.S. | 77.0 | 20.97 | 100.00 | 7.04 | 33.59 | .32 | 9.87 | 12.9 |

| STREAM NAME | POUNDS PER HOUR | PERCENT OF SYSTEM | CUMULATIVE PERCENT SYSTEM | PERCENT OF WHEAT | CUMULATIVE PERCENT WHEAT | ASH | PROTEIN | MOISTURE |
|---|---|---|---|---|---|---|---|---|
| **** 3 BK | HRS-L **** | | | | | | | |
| +12TT 4 BC | 191.0 | 40.25 | 40.25 | 17.61 | 17.61 | 4.17 | 12.30 | 13.3 |
| +22TT 4 BF | 110.0 | 23.18 | 63.44 | 10.14 | 27.75 | 3.88 | 14.42 | 13.5 |
| +56GG P-4 | 105.5 | 22.23 | 85.67 | 9.73 | 37.48 | .96 | 11.25 | 14.4 |
| +12XX B RD | 38.0 | 8.01 | 93.68 | 3.50 | 40.99 | .25 | 10.94 | 15.1 |
| -12XX FL | 30.0 | 6.32 | 100.00 | 2.77 | 43.75 | .38 | 11.90 | 14.7 |
| **** 3 BK | HRS-H **** | | | | | | | |
| +12TT 4 BC | 181.3 | 37.70 | 37.70 | 17.08 | 17.08 | 4.50 | 15.54 | 12.0 |
| +22TT 4 BF | 116.0 | 24.12 | 61.82 | 10.93 | 28.00 | 3.84 | 17.53 | 12.7 |
| +56GG P-4 | 116.9 | 24.31 | 86.13 | 11.01 | 39.01 | 1.10 | 13.93 | 14.2 |
| +12XX B RD | 41.8 | 8.69 | 94.82 | 3.94 | 42.95 | .40 | 14.69 | 14.5 |
| -12XX FL | 24.9 | 5.18 | 100.00 | 2.35 | 45.30 | .45 | 11.67 | 14.5 |
| **** 3 BK | GAINES **** | | | | | | | |
| +12TT 4 BC | 154.5 | 42.19 | 42.19 | 17.65 | 17.65 | 3.19 | 13.03 | 10.9 |
| +22TT 4 BF | 66.0 | 18.02 | 60.21 | 7.54 | 25.19 | 3.20 | 13.40 | 11.4 |
| +56GG P-4 | 61.4 | 16.77 | 76.98 | 7.01 | 32.20 | 1.48 | 12.22 | 12.7 |
| +12XX B RD | 53.8 | 14.69 | 91.67 | 6.15 | 38.35 | .37 | 10.18 | 13.0 |
| -12XX FL | 30.5 | 8.33 | 100.00 | 3.48 | 41.83 | .33 | 7.61 | 14.1 |
| **** 3 BK | SRW **** | | | | | | | |
| +12TT 4 BC | 183.0 | 43.47 | 43.47 | 19.22 | 19.22 | 4.97 | 14.72 | 11.8 |
| +22TT 4 BF | 67.0 | 15.91 | 59.38 | 7.04 | 26.25 | 4.64 | 16.09 | 12.9 |
| +56GG P-4 | 76.0 | 18.05 | 77.43 | 7.98 | 34.23 | 1.90 | 14.47 | 13.8 |
| +12XX B RD | 60.0 | 14.25 | 91.69 | 6.30 | 40.53 | .40 | 14.05 | 14.9 |
| -12XX FL | 35.0 | 8.31 | 100.00 | 3.68 | 44.21 | .30 | 9.90 | 14.9 |
| **** 3 BK | HRW **** | | | | | | | |
| +12XX 4 BC | 171.0 | 39.31 | 39.31 | 15.65 | 15.65 | 4.17 | 15.55 | 15.4 |
| +22XX 4 BF | 92.0 | 21.15 | 60.46 | 8.42 | 24.06 | 4.00 | 16.10 | 14.0 |
| +56GG P-4 | 95.0 | 21.84 | 82.30 | 8.69 | 32.75 | 1.22 | 12.76 | 15.1 |
| +12XX B RD | 40.0 | 9.20 | 91.49 | 3.66 | 36.41 | .42 | 12.46 | 14.4 |
| -12XX FL | 37.0 | 8.51 | 100.00 | 3.39 | 39.80 | .41 | 13.61 | 14.7 |

| STREAM NAME | POUNDS PER HOUR | PERCENT OF SYSTEM | CUMULATIVE PERCENT SYSTEM | PERCENT OF WHEAT | CUMULATIVE PERCENT WHEAT | ASH | PROTEIN | MOISTURE |
|---|---|---|---|---|---|---|---|---|
| **** B-RED | HRS-L **** | | | | | | | |
| +54GG P-2 | 100.0 | 40.92 | 40.92 | 9.22 | 9.22 | .33 | 9.68 | 15.6 |
| +9XX P-3 | 90.9 | 37.19 | 78.11 | 8.38 | 17.60 | .32 | 9.62 | 15.1 |
| +12XX 2 M | 35.1 | 14.36 | 92.47 | 3.24 | 2C.84 | .31 | 9.43 | 15.2 |
| -12XX FL | 18.4 | 7.53 | 100.00 | 1.70 | 22.54 | .32 | 9.72 | 15.1 |
| **** B-RED | HRS-H **** | | | | | | | |
| +54GG P-2 | 98.6 | 44.02 | 44.02 | 9.29 | 9.29 | .37 | 12.57 | 14.5 |
| +9XX P-3 | 84.0 | 37.50 | 81.52 | 7.91 | 17.20 | .37 | 13.13 | 14.2 |
| +12XX 2 M | 28.6 | 12.77 | 94.29 | 2.69 | 19.89 | .38 | 13.52 | 14.1 |
| -12XX FL | 12.8 | 5.71 | 100.00 | 1.21 | 21.10 | .39 | 14.08 | 14.5 |
| **** B-RED | GAINES **** | | | | | | | |
| +54GG P-2 | 89.6 | 37.22 | 37.22 | 10.24 | 1C.24 | .31 | 7.89 | 13.9 |
| +9XX P-3 | 83.6 | 34.73 | 71.96 | 9.55 | 19.79 | .34 | 8.70 | 14.0 |
| +12XX 2M | 21.1 | 8.77 | 80.72 | 2.41 | 22.20 | .33 | 9.00 | 14.0 |
| -12XX FL | 46.4 | 19.28 | 100.00 | 5.30 | 27.50 | .33 | 8.28 | 13.8 |
| **** B-RED | SRW **** | | | | | | | |
| +54GG P-2 | 95.0 | 30.84 | 30.84 | 9.98 | 9.98 | .31 | 10.89 | 14.7 |
| +9XX P-3 | 95.0 | 30.84 | 61.69 | 9.98 | 19.95 | .32 | 11.38 | 14.6 |
| +12XX 2M | 47.0 | 15.26 | 76.95 | 4.94 | 24.89 | .30 | 12.08 | 14.6 |
| -12XX FL | 71.0 | 23.05 | 100.00 | 7.46 | 32.34 | .27 | 10.42 | 15.0 |
| **** B-RED | HRW **** | | | | | | | |
| +54GG P-2 | 96.0 | 41.56 | 41.56 | 8.78 | 8.78 | .38 | 10.59 | 14.7 |
| +9XX P-3 | 88.0 | 38.10 | 79.65 | 8.05 | 16.83 | .38 | 10.90 | 14.8 |
| +12XX 2M | 37.0 | 16.02 | 95.67 | 3.39 | 2C.22 | .38 | 10.93 | 14.2 |
| -12XX FL | 10.0 | 4.33 | 100.00 | .91 | 21.13 | .40 | 10.91 | 14.1 |

| STREAM NAME | POUNDS PER HOUR | PERCENT OF SYSTEM | CUMULATIVE PERCENT SYSTEM | PERCENT OF WHEAT | CUMULATIVE PERCENT WHEAT | ASH | PROTEIN | MOISTURE |
|---|---|---|---|---|---|---|---|---|
| **** P-2 | HRS-L **** | | | | | | | |
| ASP 5 BK | 1.1 | 1.14 | 1.14 | .10 | .10 | 1.61 | 9.98 | 14.7 |
| +34GG 1T | 1.9 | 1.97 | 3.12 | .18 | .28 | 1.52 | 9.75 | 15.3 |
| +36GG C.S. | 4.4 | 4.57 | 7.68 | .41 | .68 | .68 | 9.92 | 15.0 |
| -36GG F.S. | 64.1 | 66.56 | 74.25 | 5.91 | 6.59 | .31 | 9.70 | 15.8 |
| -46GG 2M | 24.8 | 25.75 | 100.00 | 2.29 | 8.88 | .26 | 9.59 | 14.8 |
| **** P-2 9 | HRS-H **** | | | | | | | |
| ASP 5 BK | .5 | .52 | .52 | .05 | .05 | 1.27 | 15.21 | 11.8 |
| +34GG 1T | 1.4 | 1.44 | 1.96 | .13 | .18 | .53 | 12.36 | 13.7 |
| +36GG C.S. | 2.9 | 2.99 | 4.95 | .27 | .45 | 1.09 | 13.26 | 13.1 |
| -36GG F.S. | 50.9 | 52.53 | 57.48 | 4.79 | 5.25 | .34 | 12.43 | 14.2 |
| -46GG 2M | 41.2 | 42.52 | 100.00 | 3.88 | 9.13 | .31 | 12.69 | 14.6 |
| **** P-2 | GAINES **** | | | | | | | |
| ASP 5 BK | .4 | .47 | .47 | .05 | .05 | .99 | 8.32 | 13.2 |
| +34GG 1T | 2.7 | 3.16 | 3.63 | .31 | .35 | .68 | 8.44 | 13.4 |
| +36GG C.S. | 2.7 | 3.16 | 6.79 | .31 | .66 | .42 | 7.67 | 13.7 |
| -36GG F.S. | 53.7 | 62.88 | 69.67 | 6.13 | 6.80 | .30 | 7.98 | 13.8 |
| -46GG 1M | 25.9 | 30.33 | 100.00 | 2.96 | 9.76 | .29 | 8.31 | 13.1 |
| **** P-2 | SRW **** | | | | | | | |
| ASP 5 BK | 3.9 | 4.11 | 4.11 | .41 | .41 | .50 | 8.95 | 14.5 |
| +34GG 1T | 2.1 | 2.21 | 6.32 | .22 | .63 | .35 | 10.22 | 14.2 |
| +36GG C.S. | 4.0 | 4.21 | 10.53 | .42 | 1.05 | .45 | 9.54 | 14.4 |
| -36GG F.S. | 63.0 | 66.32 | 76.84 | 6.62 | 7.67 | .29 | 10.86 | 14.5 |
| -46GG 1M | 22.0 | 23.16 | 100.00 | 2.31 | 9.98 | .27 | 11.16 | 14.5 |
| **** P-2 | HRW **** | | | | | | | |
| ASP 5 BK | .0 | .00 | .00 | .00 | .00 | .00 | .00 | .0 |
| +34GG 1T | .0 | .00 | .00 | .00 | .00 | 1.37 | 11.38 | 12.3 |
| +36GG C.S. | .0 | .00 | .00 | .00 | .00 | .32 | 10.62 | 10.9 |
| -36GG F.S. | 38.0 | 40.43 | 40.43 | 3.48 | 3.48 | .42 | 10.42 | 14.2 |
| -46GG 1M | 56.0 | 59.57 | 100.00 | 5.12 | 8.60 | .34 | 10.39 | 13.9 |

| STREAM NAME | POUNDS PER HOUR | PERCENT OF SYSTEM | CUMULATIVE PERCENT SYSTEM | PERCENT OF WHEAT | CUMULATIVE PERCENT WHEAT | ASH | PROTEIN | MOISTURE |
|---|---|---|---|---|---|---|---|---|
| **** P-3 | HRS-L **** | | | | | | | |
| +42GG 1T | 2.1 | 2.30 | 2.30 | .19 | .19 | .57 | 9.52 | 15.1 |
| +50GG 2Q | 14.4 | 15.75 | 18.05 | 1.33 | 1.52 | .50 | 9.45 | 15.4 |
| -50GG 1M | 53.3 | 58.32 | 76.37 | 4.91 | 6.44 | .30 | 9.57 | 15.5 |
| -64GG IM | 21.6 | 23.63 | 100.00 | 1.99 | 8.43 | .56 | 9.85 | 15.3 |
| **** P-3 9 | HRS-H **** | | | | | | | |
| +42GG 1T | .6 | .75 | .75 | .06 | .06 | .83 | 14.10 | 13.4 |
| +50GG 2Q | 5.9 | 7.39 | 8.15 | .56 | .61 | .81 | 14.12 | 13.5 |
| -50GG 1M | 42.1 | 52.76 | 60.90 | 3.97 | 4.58 | .33 | 13.23 | 14.2 |
| -64GG IM | 31.2 | 39.10 | 100.00 | 2.94 | 7.52 | .27 | 12.80 | 14.0 |
| **** P-3 | GAINES **** | | | | | | | |
| +42GG 1T | 1.3 | 1.60 | 1.60 | .15 | .15 | .50 | 8.76 | 13.6 |
| +50GG 2Q | 11.7 | 14.37 | 15.97 | 1.34 | 1.49 | .43 | 8.40 | 14.0 |
| -50GG 1M | 45.1 | 55.41 | 71.38 | 5.15 | 6.64 | .31 | 8.49 | 13.9 |
| -64GG 2M | 23.3 | 28.62 | 100.00 | 2.66 | 9.30 | .28 | 8.78 | 13.8 |
| **** P-3 | SRW **** | | | | | | | |
| +42GG 1T | .0 | .00 | .00 | .00 | .00 | .00 | .00 | .0 |
| +50GG 2Q | .6 | .58 | .58 | .06 | .06 | .44 | 10.41 | 14.1 |
| -50GG 1M | 31.5 | 30.55 | 31.13 | 3.31 | 3.37 | .36 | 11.25 | 14.4 |
| -64GG 2M | 71.0 | 68.87 | 100.00 | 7.46 | 10.83 | .27 | 11.57 | 14.5 |
| **** P-3 | HRW **** | | | | | | | |
| +42GG 1T | .0 | .00 | .00 | .00 | .00 | 1.36 | 11.10 | 11.7 |
| +50GG 2Q | .0 | .00 | .00 | .00 | .00 | .00 | .00 | .0 |
| -50GG 1M | 72.0 | 85.71 | 85.71 | 6.59 | 6.59 | .37 | 11.01 | 14.1 |
| -64GG 2M | 12.0 | 14.29 | 100.00 | 1.10 | 7.69 | .31 | 10.61 | 14.1 |
| **** P-3 | HRW-4 **** | | | | | | | |
| +42GG 1T | 3.1 | 3.37 | 3.37 | .28 | .28 | .76 | 11.63 | 13.5 |
| +50GG 2Q | 8.1 | 8.78 | 12.15 | .74 | 1.02 | .61 | 11.31 | 13.3 |
| -50GG 1M | 26.5 | 28.78 | 40.93 | 2.43 | 3.45 | .35 | 10.65 | 14.4 |
| -64GG 2M | 54.5 | 59.07 | 100.00 | 4.98 | 8.43 | .31 | 10.38 | 13.8 |

| STREAM NAME | POUNDS PER HOUR | PERCENT OF SYSTEM | CUMULATIVE PERCENT SYSTEM | PERCENT OF WHEAT | CUMULATIVE PERCENT WHEAT | ASH | PROTEIN | MOISTURE |
|---|---|---|---|---|---|---|---|---|
| **** P-4 | HRS-L **** | | | | | | | |
| +26GG 1T | 15.8 | 15.94 | 15.94 | 1.46 | 1.46 | 3.39 | 14.57 | 13.8 |
| +36GG 2Q | 9.9 | 9.99 | 25.93 | .91 | 2.37 | 1.91 | 12.69 | 14.6 |
| -36GG 2Q | 15.4 | 15.54 | 41.47 | 1.42 | 3.79 | .78 | 11.30 | 15.5 |
| -44GG F.S. | 58.0 | 58.53 | 100.00 | 5.35 | 9.14 | .39 | 10.16 | 10.3 |
| **** P-4 9 | HRS-H **** | | | | | | | |
| +26GG 1T | 19.5 | 18.93 | 18.93 | 1.84 | 1.84 | 3.34 | 16.69 | 12.4 |
| +36GG 2Q | 9.6 | 9.32 | 28.25 | .90 | 2.74 | 1.89 | 14.25 | 13.7 |
| -36GG 2Q | 13.9 | 13.50 | 41.75 | 1.31 | 4.05 | .83 | 12.90 | 14.0 |
| -44GG F.S. | 60.0 | 58.25 | 100.00 | 5.65 | 9.70 | .39 | 13.33 | 14.2 |
| **** P-4 | GAINES **** | | | | | | | |
| +26GG 1T | 13.4 | 24.23 | 24.23 | 1.53 | 1.53 | 2.85 | 14.66 | 12.6 |
| +36GG 2Q | 7.0 | 12.66 | 36.89 | .80 | 2.33 | 2.55 | 15.98 | 12.3 |
| -36GG 2Q | 13.6 | 24.59 | 61.48 | 1.55 | 3.88 | 1.39 | 12.40 | 13.3 |
| -44GG F.S. | 21.3 | 38.52 | 100.00 | 2.43 | 6.32 | .50 | 9.72 | 14.2 |
| **** P-4 | SRW **** | | | | | | | |
| +26GG 1T | 6.5 | 13.46 | 13.46 | .68 | .68 | 3.26 | 15.82 | 13.0 |
| +36GG 2Q | 7.8 | 16.15 | 29.61 | .82 | 1.50 | 3.17 | 17.81 | 13.1 |
| -36GG 2Q | 34.0 | 70.39 | 100.00 | 3.57 | 5.07 | 2.49 | 16.36 | 13.8 |
| -44GG F.S. | .0 | .00 | 100.00 | .00 | 5.07 | 1.21 | 14.00 | 14.6 |
| **** P-4 | HRW **** | | | | | | | |
| +26GG 1T | 13.0 | 13.27 | 13.27 | 1.19 | 1.19 | 3.78 | 17.20 | 13.5 |
| +36GG 2Q | 2.0 | 2.04 | 15.31 | .18 | 1.37 | 2.37 | 14.00 | 9.1 |
| -36GG 2Q | 11.0 | 11.22 | 26.53 | 1.01 | 2.38 | 1.50 | 12.87 | 13.8 |
| -44GG F.S. | 72.0 | 73.47 | 100.00 | 6.59 | 8.97 | .56 | 12.21 | 14.8 |

| STREAM NAME | POUNDS PER HOUR | PERCENT OF SYSTEM | CUMULATIVE PERCENT SYSTEM | PERCENT OF WHEAT | CUMULATIVE PERCENT WHEAT | ASH | PROTEIN | MOISTURE |
|---|---|---|---|---|---|---|---|---|
| **** C.S. | HRS-L **** | | | | | | | |
| +22GG 1T | 9.6 | 4.30 | 4.30 | .89 | .89 | 3.74 | 21.02 | 14.9 |
| +70GG P-5 | 186.0 | 83.33 | 87.63 | 17.15 | 18.04 | .49 | 9.81 | 15.8 |
| +11XX 1M | 10.4 | 4.66 | 92.29 | .96 | 18.99 | .26 | 9.70 | 14.9 |
| -10XX T.FL | 16.6 | 7.44 | 99.73 | 1.53 | 2C.53 | .29 | 10.02 | 15.0 |
| -11XX B.FL | .6 | .27 | 100.00 | .06 | 2C.58 | .26 | 9.56 | 14.5 |
| **** C.S. | HRS-H **** | | | | | | | |
| +22GG 1T | 9.6 | 4.04 | 4.04 | .90 | .90 | 3.32 | 22.26 | 11.9 |
| +70GG P-5 | 203.3 | 85.60 | 89.64 | 19.15 | 2C.05 | .47 | 11.24 | 14.3 |
| +11XX 1M | 8.3 | 3.49 | 93.14 | .78 | 2C.83 | .27 | 11.20 | 14.0 |
| -10XX T.FL | 15.4 | 6.48 | 99.62 | 1.45 | 22.29 | .31 | 12.07 | 14.5 |
| -11XX B.FL | .9 | .38 | 100.00 | .08 | 22.37 | .28 | 11.29 | 14.7 |
| **** C.S. | GAINES **** | | | | | | | |
| +22GG 1T | 8.2 | 5.06 | 5.06 | .94 | .94 | 3.03 | 20.40 | 11.9 |
| +70GG P-5 | 135.0 | 83.33 | 88.40 | 15.42 | 16.36 | .44 | 7.67 | 13.7 |
| +11XX 1M | 5.9 | 3.64 | 92.04 | .67 | 17.03 | .28 | 7.36 | 13.5 |
| -10XX T.FL | 12.1 | 7.47 | 99.51 | 1.38 | 18.41 | .27 | 6.26 | 13.5 |
| -11XX B.FL | .8 | .49 | 100.00 | .09 | 18.51 | .26 | 7.29 | 13.9 |
| **** C.S. | SRW **** | | | | | | | |
| +22GG 1T | 9.3 | 7.15 | 7.15 | .98 | .98 | 2.76 | 17.24 | 12.7 |
| +70GG P-5 | 110.0 | 84.55 | 91.70 | 11.55 | 12.53 | .49 | 10.19 | 13.9 |
| +11XX 1M | 1.5 | 1.15 | 92.85 | .16 | 12.69 | .25 | 10.40 | 14.0 |
| -10XX T.FL | 8.7 | 6.69 | 99.54 | .91 | 13.60 | .24 | 7.76 | 14.7 |
| -11XX B.FL | .6 | .46 | 100.00 | .06 | 13.66 | .25 | 10.38 | 14.7 |
| **** C.S. | HRW **** | | | | | | | |
| +22GG 1T | 10.0 | 4.05 | 4.05 | .91 | .91 | 3.17 | 18.92 | 13.2 |
| +70GG P-5 | 215.0 | 87.04 | 91.09 | 19.67 | 2C.59 | .46 | 9.92 | 14.2 |
| +11XX 1M | 7.0 | 2.83 | 93.93 | .64 | 21.23 | .32 | .00 | 14.0 |
| -10XX T.FL | 14.0 | 5.67 | 99.60 | 1.28 | 22.51 | .36 | 10.23 | 13.4 |
| -11XX B.FL | 1.0 | .40 | 100.00 | .09 | 22.60 | .33 | 10.39 | 13.9 |

| STREAM NAME | POUNDS PER HOUR | PERCENT OF SYSTEM | CUMULATIVE PERCENT SYSTEM | PERCENT OF WHEAT | CUMULATIVE PERCENT WHEAT | ASH | PROTEIN | MOISTURE |
|---|---|---|---|---|---|---|---|---|
| **** P-5 | HRS-L **** | | | | | | | |
| +24GG 1T | 1.7 | .88 | .88 | .16 | .16 | 2.84 | 13.80 | 9.0 |
| +28GG 2Q | 2.8 | 1.46 | 2.34 | .26 | .41 | 2.31 | 12.83 | 14.2 |
| -28GG F.S. | 22.7 | 11.80 | 14.14 | 2.09 | 2.51 | 1.11 | 10.51 | 14.9 |
| -44GG 1M | 165.1 | 85.86 | 100.00 | 15.22 | 17.73 | .39 | 9.68 | 15.6 |
| **** P-5 | HRS-H **** | | | | | | | |
| +24GG 1T | 2.7 | 6.47 | 6.47 | .25 | .25 | 2.96 | 17.53 | 12.7 |
| +28GG 2Q | 3.8 | 9.11 | 15.59 | .36 | .61 | 2.09 | 14.65 | 13.7 |
| -28GG F.S. | 35.2 | 84.41 | 100.00 | 3.32 | 3.93 | .99 | 11.68 | 13.1 |
| -44GG 1M | .0 | .00 | 100.00 | .00 | 3.93 | .29 | 11.04 | 14.3 |
| **** P-5 | GAINES **** | | | | | | | |
| +24GG 1T | 1.1 | .73 | .73 | .13 | .13 | 2.97 | 18.78 | 13.0 |
| +28GG 2Q | 1.7 | 1.13 | 1.87 | .19 | .32 | 2.27 | 14.38 | 12.7 |
| -28GG F.S. | 22.0 | 14.69 | 16.56 | 2.51 | 2.83 | .99 | 9.33 | 13.4 |
| -44GG 1M | 125.0 | 83.44 | 100.00 | 14.28 | 17.11 | .31 | 7.28 | 13.8 |
| **** P-5 | SRW **** | | | | | | | |
| +24GG 1T | .9 | .81 | .81 | .09 | .09 | 2.38 | 14.09 | 13.3 |
| +28GG 2Q | 3.3 | 2.99 | 3.80 | .35 | .44 | 1.59 | 11.63 | 13.5 |
| -28GG F.S. | 25.3 | 22.90 | 26.70 | 2.66 | 3.10 | 1.01 | 10.46 | 14.5 |
| -44GG 1M | 81.0 | 73.30 | 100.00 | 8.51 | 11.60 | .36 | 10.18 | 14.7 |
| **** P-5 | HRW **** | | | | | | | |
| +24GG 1T | 6.0 | 2.99 | 2.99 | .55 | .55 | 4.49 | 14.97 | 13.8 |
| +28GG 2Q | 16.0 | 7.96 | 10.95 | 1.46 | 2.01 | 1.39 | 11.90 | 13.3 |
| -28GG F.S. | 63.0 | 31.34 | 42.29 | 5.76 | 7.78 | .47 | 11.81 | 14.8 |
| -44GG 1M | 116.0 | 57.71 | 100.00 | 10.61 | 18.39 | .31 | 9.87 | 14.6 |

| STREAM NAME | POUNDS PER HOUR | PERCENT OF SYSTEM | CUMULATIVE PERCENT SYSTEM | PERCENT OF WHEAT | CUMULATIVE PERCENT WHEAT | ASH | PROTEIN | MOISTURE |
|---|---|---|---|---|---|---|---|---|
| **** F.S. | HRS-L **** | | | | | | | |
| +40GG 1T | 7.0 | 3.07 | 3.07 | .65 | .65 | 2.09 | 12.44 | 13.6 |
| +70GG P-6 | 126.4 | 55.49 | 58.56 | 11.66 | 12.30 | .43 | 9.72 | 14.2 |
| +11XX 1M | 58.1 | 25.50 | 84.06 | 5.36 | 17.66 | .26 | 9.86 | 15.4 |
| -10XX T.FL | 33.5 | 14.71 | 98.77 | 3.09 | 20.75 | .29 | 10.25 | 14.4 |
| -11XX B.FL | 2.8 | 1.23 | 100.00 | .26 | 21.01 | .28 | 9.88 | 14.7 |
| **** F.S. | HRS-H **** | | | | | | | |
| +40GG 1T | 8.1 | 3.62 | 3.62 | .76 | .76 | 1.78 | 14.60 | 12.8 |
| +70GG P-6 | 117.6 | 52.57 | 56.19 | 11.08 | 11.84 | .42 | 12.23 | 14.2 |
| +11XX 1M | 59.5 | 26.60 | 82.79 | 5.60 | 17.44 | .38 | 12.49 | 13.9 |
| -10XX T.FL | 35.3 | 15.78 | 98.57 | 3.32 | 20.77 | .31 | 12.13 | 14.2 |
| -11XX B.FL | 3.2 | 1.43 | 100.00 | .30 | 21.07 | .29 | 11.09 | 14.7 |
| **** F.S. | GAINES **** | | | | | | | |
| +40GG 1T | 6.8 | 4.14 | 4.14 | .78 | .78 | 2.06 | 13.45 | 12.4 |
| +70GG P-6 | 89.0 | 54.14 | 58.27 | 10.17 | 10.94 | .41 | 7.95 | 13.5 |
| +11XX 1M | 39.5 | 24.03 | 82.30 | 4.51 | 15.46 | .27 | 8.00 | 12.9 |
| -10XX T.FL | 26.5 | 16.12 | 98.42 | 3.03 | 18.48 | .28 | 6.78 | 13.8 |
| -11XX B.FL | 2.6 | 1.58 | 100.00 | .30 | 18.78 | .28 | 7.39 | 13.9 |
| **** F.S. | SRW **** | | | | | | | |
| +40GG 1T | 9.0 | 5.23 | 5.23 | .95 | .95 | 1.39 | 11.83 | 13.5 |
| +70GG P-6 | 69.0 | 40.12 | 45.35 | 7.25 | 8.19 | .66 | 11.57 | 13.8 |
| +11XX 1M | 53.0 | 30.81 | 76.16 | 5.57 | 13.76 | .27 | 11.68 | 14.6 |
| -10XX T.FL | 34.0 | 19.77 | 95.93 | 3.57 | 17.33 | .26 | 8.79 | 14.9 |
| -11XX B.FL | 7.0 | 4.07 | 100.00 | .74 | 18.06 | .25 | 10.51 | 14.9 |
| **** F.S. | HRW **** | | | | | | | |
| +40GG 1T | 13.0 | 5.35 | 5.35 | 1.19 | 1.19 | 1.68 | 11.69 | 13.2 |
| +70GG P-6 | 129.0 | 53.09 | 58.44 | 11.80 | 12.99 | .42 | 10.32 | 14.2 |
| +11XX 1M | 66.0 | 27.16 | 85.60 | 6.04 | 19.03 | .29 | 10.72 | 14.2 |
| -10XX T.FL | 32.0 | 13.17 | 98.77 | 2.93 | 21.96 | .33 | 10.79 | 13.9 |
| -11XX B.FL | 3.0 | 1.23 | 100.00 | .27 | 22.23 | .33 | 10.61 | 13.3 |

| STREAM NAME | POUNDS PER HOUR | PERCENT OF SYSTEM | CUMULATIVE PERCENT SYSTEM | PERCENT OF WHEAT | CUMULATIVE PERCENT WHEAT | ASH | PROTEIN | MOISTURE |
|---|---|---|---|---|---|---|---|---|
| **** 1 M | HRS-L **** | | | | | | | |
| +40GG 1 T | .8 | .27 | .27 | .07 | .07 | 2.19 | 12.86 | 13.7 |
| +70GG P-6 | 31.6 | 10.71 | 10.98 | 2.91 | 2.99 | .68 | 10.02 | 15.0 |
| +11XX 2 M | 125.4 | 42.51 | 53.49 | 11.56 | 14.55 | .27 | 9.35 | 12.6 |
| -10XX T.FL | 103.7 | 35.15 | 88.64 | 9.56 | 24.11 | .24 | 9.50 | 14.9 |
| -11XX B.FL | 33.5 | 11.36 | 100.00 | 3.09 | 27.20 | .25 | 9.50 | 14.9 |
| **** 1 M | HRS-H **** | | | | | | | |
| +40GG 1 T | .4 | .13 | .13 | .04 | .04 | 1.88 | 14.81 | 12.9 |
| +70GG P-6 | 34.2 | 11.15 | 11.29 | 3.22 | 3.26 | .56 | 11.81 | 14.1 |
| +11XX 2 M | 151.4 | 49.38 | 60.67 | 14.26 | 17.52 | .28 | 11.99 | 13.9 |
| -10XX T.FL | 75.1 | 24.49 | 85.16 | 7.07 | 24.59 | .27 | 11.39 | 14.7 |
| -11XX B.FL | 45.5 | 14.84 | 100.00 | 4.29 | 28.88 | .28 | 15.89 | 14.5 |
| **** 1M | GAINES **** | | | | | | | |
| +40GG 1T | 1.6 | .64 | .64 | .18 | .18 | 1.96 | 12.57 | 12.4 |
| +70GG P-6 | 20.6 | 8.18 | 8.82 | 2.35 | 2.54 | .54 | 8.13 | 13.3 |
| +11XX 2M | 108.4 | 43.05 | 51.87 | 12.38 | 14.92 | .28 | 8.02 | 13.1 |
| -10XX T.FL | 57.7 | 22.92 | 74.78 | 6.59 | 21.51 | .25 | 6.80 | 14.0 |
| -11XX B.FL | 63.5 | 25.22 | 100.00 | 7.25 | 28.76 | .29 | 7.48 | 13.8 |
| **** 1M | SRW **** | | | | | | | |
| +40GG 1T | 2.0 | 1.24 | 1.24 | .21 | .21 | 2.64 | 14.68 | 12.1 |
| +70GG P-6 | 21.0 | 13.04 | 14.29 | 2.21 | 2.42 | .67 | 11.29 | 13.9 |
| +11XX 2M | 71.0 | 44.10 | 58.39 | 7.46 | 9.87 | .30 | 11.86 | 14.4 |
| -10XX T.FL | 30.0 | 18.63 | 77.02 | 3.15 | 13.02 | .23 | 8.67 | 14.7 |
| -11XX B.FL | 37.0 | 22.98 | 100.00 | 3.89 | 16.91 | .23 | 9.78 | 14.7 |
| **** 1M | HRW **** | | | | | | | |
| +40GG 1T | .3 | .10 | .10 | .03 | .03 | 1.58 | 12.37 | 13.1 |
| +70GG P-6 | 25.0 | 8.16 | 8.26 | 2.29 | 2.31 | .58 | 10.33 | 13.4 |
| +11XX 2M | 136.0 | 44.40 | 52.66 | 12.44 | 14.76 | .30 | 10.40 | 14.0 |
| -10XX T.FL | 101.0 | 32.97 | 85.63 | 9.24 | 24.00 | .29 | 10.46 | 13.7 |
| -11XX B.FL | 44.0 | 14.37 | 100.00 | 4.03 | 28.02 | .28 | 10.71 | 14.1 |

| STREAM NAME | POUNDS PER HCUR | PERCENT OF SYSTEM | CUMULATIVE PERCENT SYSTEM | PERCENT OF WHEAT | CUMULATIVE PERCENT WHEAT | ASH | PROTEIN | MOISTURE |
|---|---|---|---|---|---|---|---|---|
| **** P-6 | HRS-L **** | | | | | | | |
| +26GG 1T | .4 | .14 | .14 | .04 | .04 | .00 | .00 | .0 |
| +40GG 2Q | 16.2 | 5.71 | 5.85 | 1.49 | 1.53 | 1.31 | 10.99 | 14.7 |
| -40GG 2Q | 133.0 | 46.90 | 52.75 | 12.26 | 13.79 | .37 | 9.83 | 15.1 |
| -52GG 2M | 134.0 | 47.25 | 100.00 | 12.36 | 26.15 | .38 | 9.80 | 14.9 |
| **** P-6 | HRS-H **** | | | | | | | |
| +26GG 1T | .4 | .14 | .14 | .04 | .04 | 1.67 | 13.97 | 12.6 |
| +40GG 2Q | 20.7 | 7.37 | 7.51 | 1.95 | 1.99 | 1.40 | 12.50 | 14.0 |
| -40GG 2Q | 133.2 | 47.42 | 54.93 | 12.55 | 14.53 | .35 | 12.20 | 14.0 |
| -52GG 2M | 126.6 | 45.07 | 100.00 | 11.92 | 26.46 | .37 | 12.07 | 13.8 |
| **** P-6 | GAINES **** | | | | | | | |
| +26GG 1T | .3 | .28 | .28 | .03 | .03 | .72 | 8.44 | 13.4 |
| +40GG 2Q | 8.9 | 8.34 | 8.62 | 1.02 | 1.05 | 1.09 | 9.21 | 13.2 |
| -40GG 2Q | .0 | .00 | 8.62 | .00 | 1.05 | .00 | .00 | .0 |
| -52GG 2M | 97.5 | 91.38 | 100.00 | 11.14 | 12.19 | .38 | 7.90 | 14.0 |
| **** P-6 | SRW **** | | | | | | | |
| +26GG 1T | .1 | .18 | .18 | .01 | .01 | .82 | 11.15 | 14.4 |
| +40GG 2Q | 9.7 | 17.38 | 17.56 | 1.02 | 1.03 | .00 | .00 | .0 |
| -40GG 2Q | 46.0 | 82.44 | 100.00 | 4.83 | 5.86 | .00 | .00 | .0 |
| -52GG 2M | .0 | .00 | 100.00 | .00 | 5.86 | .00 | .00 | .0 |
| **** P-6 | HRW **** | | | | | | | |
| +26GG 1T | 3.0 | 1.99 | 1.99 | .27 | .27 | 1.39 | 11.25 | 13.6 |
| +40GG 2Q | 5.0 | 3.31 | 5.30 | .46 | .73 | .78 | 10.85 | 13.6 |
| -40GG 2Q | 20.0 | 13.25 | 18.54 | 1.83 | 2.56 | .76 | .00 | 13.6 |
| -52GG 2M | 123.0 | 81.46 | 100.00 | 11.25 | 13.82 | .34 | 10.54 | 14.3 |

| STREAM NAME | POUNDS PER HOUR | PERCENT OF SYSTEM | CUMULATIVE PERCENT SYSTEM | PERCENT OF WHEAT | CUMULATIVE PERCENT WHEAT | ASH | PROTEIN | MOISTURE |
|---|---|---|---|---|---|---|---|---|
| **** 2 M | HRS-L **** | | | | | | | |
| +40GG 1T | 1.6 | .51 | .51 | .15 | .15 | 2.48 | 13.70 | 13.4 |
| +70GG P-6 | 35.7 | 11.28 | 11.78 | 3.29 | 3.44 | .70 | 10.26 | 14.5 |
| +11XX 3 M | 137.4 | 43.40 | 55.18 | 12.67 | 16.11 | .28 | 9.70 | 14.9 |
| -10XX T.FL | 119.3 | 37.68 | 92.86 | 11.00 | 27.11 | .25 | 9.77 | 14.6 |
| -11XX B.FL | 22.6 | 7.14 | 100.00 | 2.08 | 29.19 | .25 | 9.47 | 14.6 |
| **** 2 M | HRS-H **** | | | | | | | |
| +40GG 1T | 1.5 | .44 | .44 | .14 | .14 | 1.38 | 13.96 | 12.5 |
| +70GG P-6 | 33.6 | 9.76 | 10.20 | 3.16 | 3.31 | .60 | 12.50 | 13.3 |
| +11XX 3 M | 141.9 | 41.24 | 51.44 | 13.37 | 16.67 | .30 | 12.30 | 13.3 |
| -10XX T.FL | 126.7 | 36.82 | 88.26 | 11.93 | 28.61 | .29 | 14.83 | 14.2 |
| -11XX B.FL | 40.4 | 11.74 | 100.00 | 3.81 | 32.41 | .25 | 12.06 | 14.4 |
| **** 2M | GAINES **** | | | | | | | |
| +40GG 1T | 1.0 | .41 | .41 | .11 | .11 | 2.15 | 14.07 | 12.0 |
| +70GG P-7 | 30.9 | 12.66 | 13.07 | 3.53 | 3.64 | .61 | 8.64 | 13.4 |
| +11XX 3M | 102.2 | 41.87 | 54.94 | 11.67 | 15.32 | .30 | 8.34 | 13.4 |
| -10XX T.FL | 78.0 | 31.95 | 86.89 | 8.91 | 24.23 | .28 | 7.49 | 13.9 |
| -11XX B.FL | 32.0 | 13.11 | 100.00 | 3.66 | 27.88 | .28 | 7.97 | 13.7 |
| **** 2M | SRW **** | | | | | | | |
| +40GG 1T | 1.8 | .63 | .63 | .19 | .19 | 3.05 | 17.12 | 12.6 |
| +70GG P-7 | 66.5 | 23.23 | 23.86 | 6.98 | 7.17 | .63 | 12.03 | 14.2 |
| +11XX 3M | 127.0 | 44.36 | 68.22 | 13.34 | 20.51 | .29 | 12.21 | 14.8 |
| -10XX T.FL | 58.0 | 20.26 | 88.47 | 6.09 | 26.60 | .24 | 10.47 | 14.6 |
| -11XX B.FL | 33.0 | 11.53 | 100.00 | 3.47 | 30.06 | .23 | 11.49 | 14.7 |
| **** 2M | HRW **** | | | | | | | |
| +40GG 1T | .3 | .10 | .10 | .03 | .03 | 2.45 | 14.91 | 12.3 |
| +70GG P-7 | 20.0 | 6.51 | 6.61 | 1.83 | 1.86 | .65 | 11.00 | 13.2 |
| +11XX 3M | 134.0 | 43.61 | 50.21 | 12.26 | 14.12 | .33 | 10.59 | 13.1 |
| -10XX T.FL | 126.0 | 41.00 | 91.21 | 11.53 | 25.65 | .29 | 10.43 | 13.4 |
| -11XX B.FL | 27.0 | 8.79 | 100.00 | 2.47 | 28.12 | .30 | 10.58 | 13.8 |

| STREAM NAME | POUNDS PER HOUR | PERCENT OF SYSTEM | CUMULATIVE PERCENT SYSTEM | PERCENT OF WHEAT | CUMULATIVE PERCENT WHEAT | ASH | PROTEIN | MOISTURE |
|---|---|---|---|---|---|---|---|---|
| **** 2 Q | HRS-L **** | | | | | | | |
| +24GG 1T | 9.2 | 16.31 | 16.31 | .85 | .85 | 3.38 | 15.19 | 13.4 |
| +70GG P-7 | 26.8 | 47.52 | 63.83 | 2.47 | 3.32 | 1.01 | 10.57 | 14.6 |
| +12XX 3M | 12.0 | 21.28 | 85.11 | 1.11 | 4.43 | .37 | 9.73 | 14.3 |
| -12XX FL | 8.4 | 14.89 | 100.00 | .77 | 5.20 | .47 | 10.11 | 14.1 |
| **** 2 Q | HRS-H **** | | | | | | | |
| +24GG 1T | 10.6 | 18.93 | 18.93 | 1.00 | 1.00 | 2.76 | 15.90 | 12.9 |
| +70GG P-7 | 30.3 | 54.11 | 73.04 | 2.85 | 3.85 | .91 | 12.64 | 12.9 |
| +12XX 3M | 9.3 | 16.61 | 89.64 | .88 | 4.73 | .44 | 12.84 | 13.6 |
| -12XX FL | 5.8 | 10.36 | 100.00 | .55 | 5.27 | .45 | 11.76 | 13.7 |
| **** 2Q | GAINES **** | | | | | | | |
| +24GG 1T | 10.6 | 27.82 | 27.82 | 1.21 | 1.21 | 2.73 | 16.17 | 11.7 |
| +70GG P-7 | 19.8 | 51.97 | 79.79 | 2.26 | 3.47 | 1.09 | 10.38 | 13.0 |
| +12XX 3M | 4.0 | 10.50 | 90.29 | .46 | 3.93 | .44 | 8.54 | 13.4 |
| -12XX FL | 3.7 | 9.71 | 100.00 | .42 | 4.35 | .39 | 7.38 | 13.8 |
| **** 2Q | SRW **** | | | | | | | |
| +24GG 1T | 43.7 | 43.70 | 43.70 | 4.59 | 4.59 | 3.24 | 18.04 | 12.3 |
| +70GG P-7 | 41.1 | 41.10 | 84.80 | 4.32 | 8.90 | 1.49 | 12.24 | 13.6 |
| +12XX 3M | 5.2 | 5.20 | 90.00 | .55 | 9.45 | .60 | 11.17 | 13.8 |
| -12XX FL | 10.0 | 10.00 | 100.00 | 1.05 | 10.50 | .32 | 7.66 | 14.7 |
| **** 2Q | HRW **** | | | | | | | |
| +24GG 1T | 9.0 | 14.75 | 14.75 | .82 | .82 | 2.79 | 14.77 | 13.8 |
| +70GG P-7 | 42.0 | 68.85 | 83.61 | 3.84 | 4.67 | .79 | 10.53 | 13.4 |
| +12XX 3M | 6.0 | 9.84 | 93.44 | .55 | 5.22 | .43 | 10.43 | 13.4 |
| -12XX FL | 4.0 | 6.56 | 100.00 | .37 | 5.58 | .47 | 10.06 | 11.1 |

| STREAM NAME | POUNDS PER HOUR | PERCENT OF SYSTEM | CUMULATIVE PERCENT SYSTEM | PERCENT OF WHEAT | CUMULATIVE PERCENT WHEAT | ASH | PROTEIN | MOISTURE |
|---|---|---|---|---|---|---|---|---|
| **** 4 BK | HRS-L **** | | | | | | | |
| +20TT 5 BK | 214.5 | 73.58 | 73.58 | 19.78 | 19.78 | 4.99 | 13.01 | 12.1 |
| +36GG 5 BK | 19.0 | 6.52 | 80.10 | 1.75 | 21.53 | 4.04 | 15.85 | 10.5 |
| +8XX 9-7 | 29.5 | 10.12 | 90.22 | 2.72 | 24.25 | 1.21 | 12.53 | 14.9 |
| +12XX 4 M | 12.5 | 4.29 | 94.51 | 1.15 | 25.40 | .41 | 12.53 | 14.9 |
| -12XX FL | 16.0 | 5.49 | 100.00 | 1.48 | 26.88 | .43 | 13.51 | 14.7 |
| **** 4 BK | HRS-H **** | | | | | | | |
| +20TT 5 BK | 198.9 | 70.61 | 70.61 | 18.73 | 18.73 | 5.17 | 15.99 | 11.8 |
| +36GG 5 BK | 22.4 | 7.95 | 78.56 | 2.11 | 20.84 | 5.24 | 16.09 | 11.3 |
| +8XX 9-7 | 32.4 | 11.50 | 90.06 | 3.05 | 23.90 | 1.29 | 15.81 | 13.5 |
| +12XX 4 M | 12.0 | 4.26 | 94.32 | 1.13 | 25.03 | .38 | 17.58 | 13.9 |
| -12XX FL | 16.0 | 5.68 | 100.00 | 1.51 | 26.53 | .49 | 17.48 | 14.4 |
| **** 4 BK | GAINES **** | | | | | | | |
| +20TT 5 BK | 154.0 | 74.11 | 74.11 | 17.59 | 17.59 | 4.04 | 13.18 | 10.6 |
| +36GG 5 BK | 14.6 | 7.03 | 81.14 | 1.67 | 19.26 | 3.31 | 13.62 | 11.6 |
| +8XX P-7 | 14.9 | 7.17 | 88.31 | 1.70 | 20.96 | 1.86 | 13.22 | 12.2 |
| +12XX 4M | 9.6 | 4.62 | 92.93 | 1.10 | 22.06 | .46 | 12.09 | 13.2 |
| -12XX FL | 14.7 | 7.07 | 100.00 | 1.68 | 23.74 | .37 | 9.09 | 13.9 |
| **** 4 BK | SRW **** | | | | | | | |
| +20TT 5 BK | 173.0 | 74.25 | 74.25 | 18.17 | 18.17 | 5.85 | 14.48 | 13.3 |
| +36GG 5 BK | 18.0 | 7.73 | 81.97 | 1.89 | 20.06 | 4.53 | 16.55 | 12.7 |
| +8XX P-7 | 17.0 | 7.30 | 89.27 | 1.79 | 21.84 | 2.69 | 17.02 | 13.6 |
| +12XX 4M | 10.0 | 4.29 | 93.56 | 1.05 | 22.89 | .52 | 18.42 | 14.1 |
| -12XX FL | 15.0 | 6.44 | 100.00 | 1.58 | 24.47 | .38 | 12.46 | 14.4 |
| **** 4 BK | HRW **** | | | | | | | |
| +20TT 5 BK | 208.0 | 74.55 | 74.55 | 19.03 | 19.03 | 5.06 | 15.58 | 15.0 |
| +36GG 5 BK | 20.0 | 7.17 | 81.72 | 1.83 | 20.86 | 4.27 | 18.81 | 15.4 |
| +8XX P-7 | 25.0 | 8.96 | 90.68 | 2.29 | 23.15 | 1.93 | 15.31 | 15.2 |
| +12XX 4M | 12.0 | 4.30 | 94.98 | 1.10 | 24.25 | .54 | 14.77 | 14.4 |
| -12XX FL | 14.0 | 5.02 | 100.00 | 1.28 | 25.53 | .52 | 16.20 | 15.6 |

| STREAM NAME | POUNDS PER HOUR | PERCENT OF SYSTEM | CUMULATIVE PERCENT SYSTEM | PERCENT OF WHEAT | CUMULATIVE PERCENT WHEAT | ASH | PROTEIN | MOISTURE |
|---|---|---|---|---|---|---|---|---|
| **** P-7 | HRS-L **** | | | | | | | |
| +28LW 5 BK | 1.8 | 2.47 | 2.47 | .17 | .17 | 3.25 | 13.11 | 10.1 |
| +36LW 1T | 5.6 | 7.67 | 10.14 | .52 | .68 | 1.81 | 11.94 | 14.3 |
| -36LW 1T | 23.9 | 32.74 | 42.88 | 2.20 | 2.89 | .90 | 11.86 | 14.4 |
| -50LW 3M | 41.7 | 57.12 | 100.00 | 3.85 | 6.73 | .52 | 10.40 | 14.8 |
| **** P-7 | HRS-H **** | | | | | | | |
| +28LW 5 BK | 3.2 | 3.42 | 3.42 | .30 | .30 | 3.09 | 15.35 | 10.9 |
| +36LW 1T | 21.2 | 22.65 | 26.07 | 2.00 | 2.30 | 1.78 | 14.04 | 13.0 |
| -36LW 1T | 20.0 | 21.37 | 47.44 | 1.88 | 4.18 | .98 | 13.59 | 13.3 |
| -50LW 3M | 49.2 | 52.56 | 100.00 | 4.63 | 8.82 | .54 | 13.38 | 13.2 |
| **** P-7 | GAINES **** | | | | | | | |
| +28GG 5 BK | 4.3 | 6.22 | 6.22 | .49 | .49 | 2.71 | 12.38 | 11.1 |
| +36GG 1T | 35.7 | 51.66 | 57.89 | 4.08 | 4.57 | 1.73 | 11.83 | 10.6 |
| -36GG 1T | 19.0 | 27.50 | 85.38 | 2.17 | 6.74 | .84 | 10.03 | 13.4 |
| -50GG 3M | 10.1 | 14.62 | 100.00 | 1.15 | 7.89 | .66 | 10.00 | 13.1 |
| **** P-7 | SRW **** | | | | | | | |
| +28GG 5 BK | 12.0 | 13.95 | 13.95 | 1.26 | 1.26 | 2.07 | 13.40 | 12.7 |
| +36GG 1T | 33.0 | 38.37 | 52.33 | 3.47 | 4.73 | 1.40 | 13.37 | 13.8 |
| -36GG 1T | 29.0 | 33.72 | 86.05 | 3.05 | 7.77 | .87 | 12.96 | 13.1 |
| -50GG 3M | 12.0 | 13.95 | 100.00 | 1.26 | 9.03 | .63 | 12.86 | 13.7 |
| **** P-7 | HRW **** | | | | | | | |
| +28GG 5 BK | 3.0 | 2.56 | 2.56 | .27 | .27 | 3.23 | 14.85 | 12.0 |
| +36GG 1T | 36.0 | 30.77 | 33.33 | 3.29 | 3.57 | 1.39 | 12.40 | 13.3 |
| -36GG 1T | 32.0 | 27.35 | 60.68 | 2.93 | 6.50 | .49 | 10.97 | 13.8 |
| -50GG 3M | 46.0 | 39.32 | 100.00 | 4.21 | 10.70 | .73 | 10.92 | 13.4 |

| STREAM NAME | POUNDS PER HOUR | PERCENT OF SYSTEM | CUMULATIVE PERCENT SYSTEM | PERCENT OF WHEAT | CUMULATIVE PERCENT WHEAT | ASH | PROTEIN | MOISTURE |
|---|---|---|---|---|---|---|---|---|
| **** 3 M | HRS-L **** | | | | | | | |
| +60GG 1T | 12.8 | 6.28 | 6.28 | 1.18 | 1.18 | 1.40 | 11.84 | 14.3 |
| +11XX 4M | 80.9 | 39.70 | 45.98 | 7.46 | 8.64 | .39 | 9.91 | 14.1 |
| -11XX FL | 110.1 | 54.02 | 100.00 | 10.15 | 18.79 | .26 | 9.70 | 14.0 |
| **** 3 M | HRS-H **** | | | | | | | |
| +60GG 1T | 14.0 | 7.15 | 7.15 | 1.32 | 1.32 | 1.38 | 14.00 | 12.8 |
| +11XX 4M | 52.2 | 26.65 | 33.79 | 4.92 | 6.24 | .41 | 12.88 | 13.2 |
| -11XX FL | 129.7 | 66.21 | 100.00 | 12.22 | 18.45 | .24 | 12.14 | 14.3 |
| **** 3M | GAINES **** | | | | | | | |
| +60GG 1T | 9.7 | 7.34 | 7.34 | 1.11 | 1.11 | 1.46 | 11.19 | 11.6 |
| +11XX 4M | 37.9 | 28.69 | 36.03 | 4.33 | 5.44 | .43 | 8.78 | 13.8 |
| -11XX FL | 84.5 | 63.97 | 100.00 | 9.65 | 15.09 | .30 | 8.15 | 13.5 |
| **** 3M | SRW **** | | | | | | | |
| +60GG 1T | 5.0 | 3.14 | 3.14 | .53 | .53 | 2.36 | 15.90 | 12.4 |
| +11XX 4M | 81.0 | 50.94 | 54.09 | 8.51 | 9.03 | .50 | 13.05 | 13.7 |
| -11XX FL | 73.0 | 45.91 | 100.00 | 7.67 | 16.70 | .23 | 11.29 | 14.7 |
| **** 3M | HRW **** | | | | | | | |
| +64GG 1T | 4.0 | 2.35 | 2.35 | .37 | .37 | 1.96 | 13.73 | 12.3 |
| +12XX 4M | 56.0 | 32.94 | 35.29 | 5.12 | 5.49 | .47 | 10.74 | 13.5 |
| -12XX FL | 110.0 | 64.71 | 100.00 | 10.06 | 15.55 | .32 | 10.59 | 13.1 |

| STREAM NAME | POUNDS PER HOUR | PERCENT OF SYSTEM | CUMULATIVE PERCENT SYSTEM | PERCENT OF WHEAT | CUMULATIVE PERCENT WHEAT | ASH | PROTEIN | MOISTURE |
|---|---|---|---|---|---|---|---|---|
| **** 1 T | HRS-L **** | | | | | | | |
| +32GG G.SC | 37.0 | 42.63 | 42.63 | 3.41 | 3.41 | 3.93 | 16.98 | 12.4 |
| +60GG 5M | 21.3 | 24.54 | 67.17 | 1.96 | 5.38 | 2.83 | 12.95 | 15.0 |
| +13XX 4M | 22.2 | 25.58 | 92.74 | 2.05 | 7.42 | .60 | 10.35 | 14.4 |
| -13XX FL | 6.3 | 7.26 | 100.00 | .58 | 8.00 | .62 | 10.48 | 13.0 |
| **** 1 T | HRS-H **** | | | | | | | |
| +32GG G.SC | 41.1 | 43.49 | 43.49 | 3.87 | 3.87 | 3.55 | 18.14 | 10.4 |
| +60GG 5M | 25.0 | 26.46 | 69.95 | 2.35 | 6.23 | 2.16 | 14.15 | 12.5 |
| +13XX 4M | 21.4 | 22.65 | 92.59 | 2.02 | 8.24 | .65 | 13.08 | 13.2 |
| -13XX FL | 7.0 | 7.41 | 100.00 | .66 | 8.90 | .55 | 12.06 | 13.7 |
| **** 1T | GAINES **** | | | | | | | |
| +32GG G.SC | 38.3 | 35.69 | 35.69 | 4.38 | 4.38 | 3.17 | 17.42 | 13.1 |
| +60GG 5M | 37.6 | 35.04 | 70.74 | 4.30 | 8.67 | 2.03 | 12.67 | 11.1 |
| +13XX 4M | 26.2 | 24.42 | 95.15 | 2.99 | 11.66 | .63 | 9.00 | 13.0 |
| -13XX FL | 5.2 | 4.85 | 100.00 | .59 | 12.26 | .45 | 7.65 | 13.4 |
| **** 1T | SRW **** | | | | | | | |
| +32GG G.SC | 38.0 | 33.93 | 33.93 | 3.99 | 3.99 | 3.60 | 18.00 | 11.6 |
| +60GG 5M | 36.0 | 32.14 | 66.07 | 3.78 | 7.77 | 2.54 | 15.26 | 12.1 |
| +13XX 4M | 29.0 | 25.89 | 91.96 | 3.05 | 10.82 | .68 | 12.71 | 13.4 |
| -13XX FL | 9.0 | 8.04 | 100.00 | .95 | 11.76 | .32 | 7.96 | 14.7 |
| **** 1T | HRW **** | | | | | | | |
| +32GG G.SC | 37.0 | 33.33 | 33.33 | 3.39 | 3.39 | 3.86 | 18.01 | 13.1 |
| +60GG 5M | 32.0 | 28.83 | 62.16 | 2.93 | 6.31 | 2.16 | 13.47 | 12.5 |
| +13XX 4M | 36.0 | 32.43 | 94.59 | 3.29 | 9.61 | .78 | 11.84 | 15.0 |
| -13XX FL | 6.0 | 5.41 | 100.00 | .55 | 10.16 | .66 | 11.39 | 12.4 |

| STREAM NAME | POUNDS PER HOUR | PERCENT OF SYSTEM | CUMULATIVE PERCENT SYSTEM | PERCENT OF WHEAT | CUMULATIVE PERCENT WHEAT | ASH | PROTEIN | MOISTURE |
|---|---|---|---|---|---|---|---|---|
| **** 4 M | HRS-L **** | | | | | | | |
| +44GG 5 BK | .3 | .26 | .26 | .03 | .03 | .72 | 10.44 | 14.3 |
| +12XX 5M | 40.6 | 35.71 | 35.97 | 3.74 | 3.77 | .61 | 10.28 | 13.8 |
| -12XX FL | 72.8 | 64.03 | 100.00 | 6.71 | 1C.48 | .29 | 10.15 | 13.6 |
| **** 4 M | HRS-H **** | | | | | | | |
| +44GG 5 BK | .9 | .79 | .79 | .08 | .08 | .68 | 13.46 | 13.1 |
| +12XX 5M | 37.4 | 32.75 | 33.54 | 3.52 | 3.61 | .64 | 13.47 | 12.5 |
| -12XX FL | 75.9 | 66.46 | 100.00 | 7.15 | 1C.76 | .34 | 12.84 | 13.6 |
| **** 4M | GAINES **** | | | | | | | |
| +44GG 5 BK | .3 | .53 | .53 | .03 | .03 | .68 | 9.25 | 12.6 |
| +12XX 5M | 12.4 | 22.02 | 22.56 | 1.42 | 1.45 | .62 | 9.07 | 12.8 |
| -12XX FL | 43.6 | 77.44 | 100.00 | 4.98 | 6.43 | .38 | 9.35 | 13.5 |
| **** 4M | SRW **** | | | | | | | |
| +44GG 5 BK | .3 | .21 | .21 | .03 | .03 | 1.37 | 14.82 | 12.4 |
| +12XX 5M | 97.0 | 68.65 | 68.86 | 10.19 | 1C.22 | .48 | 13.09 | 13.3 |
| -12XX FL | 44.0 | 31.14 | 100.00 | 4.62 | 14.84 | .31 | 12.99 | 15.9 |
| **** 4M | HRW **** | | | | | | | |
| +44GG 5 BK | .0 | .00 | .00 | .00 | .00 | .00 | .00 | .0 |
| +12XX 5M | 41.0 | 37.27 | 37.27 | 3.75 | 3.75 | .74 | 11.23 | 12.7 |
| -12XX FL | 69.0 | 62.73 | 100.00 | 6.31 | 1C.06 | .38 | 11.57 | 12.3 |

| STREAM NAME | POUNDS PER HOUR | PERCENT OF SYSTEM | CUMULATIVE PERCENT SYSTEM | PERCENT OF WHEAT | CUMULATIVE PERCENT WHEAT | ASH | PROTEIN | MOISTURE |
|---|---|---|---|---|---|---|---|---|
| **** SUC | HRS-L **** | | | | | | | |
| +18TT 5 BK | .3 | 2.80 | 2.80 | .03 | .03 | 1.50 | 3.93 | 8.1 |
| +54GG 5 BK | 3.4 | 31.78 | 34.58 | .31 | .34 | 2.11 | 8.34 | 10.3 |
| +13XX 5M | 4.3 | 40.19 | 74.77 | .40 | .74 | .85 | 10.27 | 12.9 |
| -13XX FL | 2.7 | 25.23 | 100.00 | .25 | .99 | .49 | 10.43 | 16.7 |
| **** SUC | HRS-H **** | | | | | | | |
| +18TT 5 BK | .4 | 3.54 | 3.54 | .04 | .04 | 2.40 | 4.81 | 7.0 |
| +54GG 5 BK | 4.9 | 43.36 | 46.90 | .46 | .50 | 2.68 | 10.03 | 10.0 |
| +13XX 5M | 3.9 | 34.51 | 81.42 | .37 | .87 | 1.17 | 13.62 | 11.6 |
| -13XX FL | 2.1 | 18.58 | 100.00 | .20 | 1.06 | .49 | 12.09 | 12.5 |
| **** SUC | GAINES **** | | | | | | | |
| +18TT 5 BK | .3 | 2.03 | 2.03 | .03 | .03 | 2.68 | 4.87 | 13.4 |
| +54GG 5 BK | 3.5 | 23.65 | 25.68 | .40 | .43 | 2.40 | 9.42 | 10.5 |
| +13XX 5M | 8.6 | 58.11 | 83.78 | .98 | 1.42 | .71 | 10.21 | 12.4 |
| -13XX FL | 2.4 | 16.22 | 100.00 | .27 | 1.69 | .47 | 11.26 | 12.9 |
| **** SUC | SRW **** | | | | | | | |
| +18TT 5 BK | .3 | 1.37 | 1.37 | .03 | .03 | 2.21 | 7.11 | 10.5 |
| +54GG 5 BK | 6.3 | 28.77 | 30.14 | .66 | .69 | 1.77 | 11.20 | 12.5 |
| +13XX 5M | 10.9 | 49.77 | 79.91 | 1.14 | 1.84 | .62 | 13.31 | 13.4 |
| -13XX FL | 4.4 | 20.09 | 100.00 | .46 | 2.30 | .47 | 12.61 | 12.7 |
| **** SUC | HRW **** | | | | | | | |
| +18TT 5 BK | .0 | .00 | .00 | .00 | .00 | .00 | .00 | .0 |
| +54GG 5 BK | 3.0 | 23.08 | 23.08 | .27 | .27 | 2.71 | 9.60 | 11.3 |
| +13XX 5M | 5.0 | 38.46 | 61.54 | .46 | .73 | .98 | 11.45 | 12.1 |
| -13XX FL | 5.0 | 38.46 | 100.00 | .46 | 1.19 | .62 | 13.86 | 11.3 |

| STREAM NAME | POUNDS PER HOUR | PERCENT OF SYSTEM | CUMULATIVE PERCENT SYSTEM | PERCENT OF WHEAT | CUMULATIVE PERCENT WHEAT | ASH | PROTEIN | MOISTURE |
|---|---|---|---|---|---|---|---|---|
| **** 5 BK | HRS-L **** | | | | | | | |
| +20TT B.D. | 178.0 | 69.78 | 69.78 | 16.41 | 16.41 | 5.59 | 12.65 | 12.3 |
| +50GG S.D. | 40.5 | 15.88 | 85.65 | 3.73 | 20.15 | 3.90 | 14.84 | 11.9 |
| +13XX 5M | 18.6 | 7.29 | 92.94 | 1.72 | 21.86 | 1.30 | 12.95 | 14.3 |
| -13XX FL | 18.0 | 7.06 | 100.00 | 1.66 | 23.52 | .67 | 15.40 | 14.0 |
| **** 5 BK | HRS-H **** | | | | | | | |
| +20TT B.D. | 168.7 | 69.31 | 69.31 | 15.89 | 15.89 | 6.01 | 15.32 | 11.3 |
| +50GG S.D. | 44.0 | 18.08 | 87.39 | 4.14 | 20.03 | 3.85 | 16.16 | 10.6 |
| +13XX 5M | 14.4 | 5.92 | 93.30 | 1.36 | 21.39 | 1.48 | 16.96 | 12.8 |
| -13XX FL | 16.3 | 6.70 | 100.00 | 1.54 | 22.93 | .63 | 18.84 | 14.2 |
| **** 5 BK | GAINES **** | | | | | | | |
| +20TT B.D. | 124.5 | 69.94 | 69.94 | 14.22 | 14.22 | 4.44 | 13.14 | 11.0 |
| +50GG S.D. | 30.4 | 17.08 | 87.02 | 3.47 | 17.69 | 2.81 | 15.19 | 11.1 |
| +13XX 5M | 6.1 | 3.43 | 90.45 | .70 | 18.39 | 1.37 | 12.23 | 12.1 |
| -13XX FL | 17.0 | 9.55 | 100.00 | 1.94 | 20.33 | .52 | 10.94 | 13.5 |
| **** 5 BK | SRW **** | | | | | | | |
| +20TT B.D. | 148.6 | 70.90 | 70.90 | 15.60 | 15.60 | 6.45 | 14.09 | 13.3 |
| +50GG S.D. | 37.0 | 17.65 | 88.55 | 3.89 | 19.49 | 4.03 | 14.46 | 12.6 |
| +13XX 5M | 9.7 | 4.63 | 93.18 | 1.02 | 20.51 | 1.49 | 15.01 | 13.5 |
| -13XX FL | 14.3 | 6.82 | 100.00 | 1.50 | 22.01 | .55 | 14.43 | 14.2 |
| **** 5 BK | HRW **** | | | | | | | |
| +20TT B.D. | 174.0 | 75.00 | 75.00 | 15.92 | 15.92 | 5.54 | 15.71 | 14.6 |
| +50GG S.D. | 36.0 | 15.52 | 90.52 | 3.29 | 19.21 | 4.02 | 17.60 | 14.5 |
| +13XX 5M | 7.0 | 3.02 | 93.53 | .64 | 19.85 | 2.08 | 16.03 | 13.1 |
| -13XX FL | 15.0 | 6.47 | 100.00 | 1.37 | 21.23 | .74 | 17.99 | 13.0 |

| STREAM NAME | POUNDS PER HCUR | PERCENT OF SYSTEM | CUMULATIVE PERCENT SYSTEM | PERCENT OF WHEAT | CUMULATIVE PERCENT WHEAT | ASH | PROTEIN | MOISTURE |
|---|---|---|---|---|---|---|---|---|
| **** 5 M | HRS-L **** | | | | | | | |
| +54GG S.D. | 9.9 | 15.18 | 15.18 | .91 | .91 | 3.54 | 14.74 | 12.5 |
| +13XX 6M | 16.8 | 25.77 | 40.95 | 1.55 | 2.46 | 1.58 | 11.88 | 13.1 |
| -13XX FL | 38.5 | 59.05 | 100.00 | 3.55 | 6.01 | .45 | 10.29 | 13.1 |
| **** 5 M | HRS-H **** | | | | | | | |
| +54GG S.D. | 11.2 | 23.19 | 23.19 | 1.05 | 1.05 | 1.26 | 15.88 | 11.2 |
| +13XX 6M | 10.9 | 22.57 | 45.76 | 1.03 | 2.08 | 1.66 | 14.64 | 11.9 |
| -13XX FL | 26.2 | 54.24 | 100.00 | 2.47 | 4.55 | .40 | 12.73 | 13.5 |
| **** 5M | GAINES **** | | | | | | | |
| +54GG S.D. | 10.2 | 20.73 | 20.73 | 1.17 | 1.17 | 3.27 | 12.68 | 10.5 |
| +13XX 6M | 22.1 | 44.92 | 65.65 | 2.52 | 3.69 | 1.27 | 10.95 | 12.0 |
| -13XX FL | 16.9 | 34.35 | 100.00 | 1.93 | 5.62 | .49 | 8.74 | 13.4 |
| **** 5M | SRW **** | | | | | | | |
| +54GG S.D. | 20.0 | 20.04 | 20.04 | 2.10 | 2.10 | 3.01 | 16.68 | 11.3 |
| +13XX 6M | 46.4 | 46.49 | 66.53 | 4.87 | 6.97 | .88 | 14.12 | 12.9 |
| -13XX FL | 33.4 | 33.47 | 100.00 | 3.51 | 1C.48 | .36 | 11.00 | 14.0 |
| **** 5M | HRW **** | | | | | | | |
| +54GG S.D. | 12.0 | 25.53 | 25.53 | 1.10 | 1.10 | 1.54 | 16.70 | 10.9 |
| +13XX 6M | 11.0 | 23.40 | 48.94 | 1.01 | 2.10 | 1.47 | 12.80 | 12.0 |
| -13XX FL | 24.0 | 51.06 | 100.00 | 2.20 | 4.30 | .63 | 11.71 | 11.9 |

| STREAM NAME | POUNDS PER HOUR | PERCENT OF SYSTEM | CUMULATIVE PERCENT SYSTEM | PERCENT OF WHEAT | CUMULATIVE PERCENT WHEAT | ASH | PROTEIN | MOISTURE |
|---|---|---|---|---|---|---|---|---|
| **** B+SD | HRS-L **** | | | | | | | |
| +54GG FEED | 19.3 | 35.09 | 35.09 | 1.78 | 1.78 | 3.44 | 15.94 | 12.6 |
| +12XX 6M | 12.2 | 22.18 | 57.27 | 1.12 | 2.90 | 3.07 | 15.34 | 13.1 |
| -12XX FL | 23.5 | 42.73 | 100.00 | 2.17 | 5.07 | 1.59 | 13.67 | 13.2 |
| **** B+SD | HRS-H **** | | | | | | | |
| +54GG FEED | 26.8 | 40.18 | 40.18 | 2.52 | 2.52 | 3.32 | 16.99 | 11.9 |
| +12XX 6M | 10.8 | 16.19 | 56.37 | 1.02 | 3.54 | 2.84 | 16.83 | 12.1 |
| -12XX FL | 29.1 | 43.63 | 100.00 | 2.74 | 6.28 | 1.29 | 15.72 | 13.0 |
| **** B+SD | GAINES **** | | | | | | | |
| +54GG FEED | 10.2 | 25.37 | 25.37 | 1.17 | 1.17 | 2.79 | 12.71 | 10.7 |
| +12XX 6M | 5.0 | 12.44 | 37.81 | .57 | 1.74 | 2.35 | 13.68 | 12.0 |
| -12XX FL | 25.0 | 62.19 | 100.00 | 2.86 | 4.59 | 1.09 | 10.48 | 13.0 |
| **** B+SD | SRW **** | | | | | | | |
| +54GG FEED | 27.7 | 37.18 | 37.18 | 2.91 | 2.91 | 3.59 | 16.58 | 11.3 |
| +12XX 6M | 18.4 | 24.70 | 61.88 | 1.93 | 4.84 | .00 | .00 | .0 |
| -12XX FL | 28.4 | 38.12 | 100.00 | 2.98 | 7.82 | .98 | 13.42 | 14.1 |
| **** B+SD | HRW **** | | | | | | | |
| +54GG FEED | 17.0 | 35.42 | 35.42 | 1.56 | 1.56 | 3.81 | 18.84 | 11.9 |
| +12XX 6M | 10.0 | 20.83 | 56.25 | .91 | 2.47 | 3.02 | 17.14 | 11.7 |
| -12XX FL | 21.0 | 43.75 | 100.00 | 1.92 | 4.39 | 1.57 | 15.87 | 12.2 |

| STREAM NAME | POUNDS PER HOUR | PERCENT OF SYSTEM | CUMULATIVE PERCENT SYSTEM | PERCENT OF WHEAT | CUMULATIVE PERCENT WHEAT | ASH | PROTEIN | MOISTURE |
|---|---|---|---|---|---|---|---|---|
| **** 6 M | HRS-L **** | | | | | | | |
| +13XX R DG | 20.8 | 54.03 | 54.03 | 1.92 | 1.92 | 2.85 | 14.27 | 12.6 |
| -13XX FL | 17.7 | 45.97 | 100.00 | 1.63 | 3.55 | .84 | 11.07 | 13.0 |
| **** 6 M | HRS-H **** | | | | | | | |
| +13XX R DG | 16.0 | 35.71 | 35.71 | 1.51 | 1.51 | 2.53 | 15.97 | 11.7 |
| -13XX FL | 28.8 | 64.29 | 100.00 | 2.71 | 4.22 | .53 | 13.36 | 13.1 |
| **** 6M | GAINES **** | | | | | | | |
| +13XX R.DG | 58.2 | 58.20 | 58.20 | 6.65 | 6.65 | 1.95 | 12.59 | 11.9 |
| -13XX FL | 41.8 | 41.80 | 100.00 | 4.77 | 11.42 | .80 | 10.07 | 12.9 |
| **** 6M | SRW **** | | | | | | | |
| +13XX R.DG | 51.5 | 58.19 | 58.19 | 5.41 | 5.41 | 1.47 | 15.33 | 12.5 |
| -13XX FL | 37.0 | 41.81 | 100.00 | 3.89 | 9.29 | .39 | 12.53 | 14.2 |
| **** 6M | HRW **** | | | | | | | |
| +13XX R.DG | 12.0 | 54.55 | 54.55 | 1.10 | 1.10 | 1.64 | 14.27 | 10.8 |
| -13XX FL | 10.0 | 45.45 | 100.00 | .91 | 2.01 | .75 | 11.04 | 10.4 |

APPENDIX B

CUMULATIVE ASH AND PROTEIN

**** HRS-L YIELD=76.73 ****

| STREAM | STR WT | PCENT | S OF Q | ASH | QXA | S OF QXA | CUM ASH | PROT | CUM PROT |
|---|---|---|---|---|---|---|---|---|---|
| 1 MIDS B | 1719. | 4.55 | 4.55 | .229 | 1.04 | 1.04 | .229 | 9.6 | 9.59 |
| 2 MIDS B | 963. | 2.55 | 7.09 | .238 | .61 | 1.65 | .233 | 9.5 | 9.56 |
| 1 MIDS T | 4217. | 11.15 | 18.24 | .240 | 2.68 | 4.33 | .237 | 9.4 | 9.47 |
| 2 MIDS T | 4582. | 12.12 | 30.36 | .252 | 3.05 | 7.38 | .243 | 9.8 | 9.59 |
| C SIZ B | 39. | .10 | 30.46 | .269 | .03 | 7.41 | .243 | 9.8 | 9.59 |
| 3 MIDS | 4363. | 11.54 | 42.00 | .277 | 3.20 | 10.61 | .253 | 9.7 | 9.62 |
| F SIZ B | 90. | .24 | 42.24 | .279 | .07 | 10.68 | .253 | 10.0 | 9.62 |
| F SIZ T | 1326. | 3.51 | 45.75 | .282 | .99 | 11.66 | .255 | 9.9 | 9.65 |
| C SIZ T | 655. | 1.73 | 47.48 | .291 | .50 | 12.17 | .256 | 10.0 | 9.66 |
| 1,2,3 RED | 633. | 1.67 | 49.15 | .323 | .54 | 12.71 | .259 | 9.6 | 9.66 |
| 4 MIDS | 1994. | 5.27 | 54.43 | .344 | 1.81 | 14.52 | .267 | 10.5 | 9.74 |
| 2 BK | 1554. | 4.11 | 58.54 | .346 | 1.42 | 15.94 | .272 | 10.6 | 9.80 |
| 1 BK | 1038. | 2.74 | 61.28 | .373 | 1.02 | 16.97 | .277 | 10.0 | 9.81 |
| PRE BK | 57. | .15 | 61.43 | .379 | .06 | 17.02 | .277 | 9.4 | 9.81 |
| 3 BK | 1233. | 3.26 | 64.69 | .381 | 1.24 | 18.27 | .282 | 11.8 | 9.91 |
| 2 QUAL | 341. | .90 | 65.59 | .447 | .40 | 18.67 | .285 | 9.9 | 9.91 |
| 4 BK | 691. | 1.83 | 67.42 | .448 | .82 | 19.49 | .289 | 13.5 | 10.00 |
| SUCTION | 120. | .32 | 67.74 | .498 | .16 | 19.65 | .290 | 11.5 | 10.01 |
| 5 MIDS | 866. | 2.29 | 70.03 | .598 | 1.37 | 21.02 | .300 | 10.2 | 10.02 |
| 1 TAILS | 250. | .66 | 70.69 | .623 | .41 | 21.43 | .303 | 10.5 | 10.02 |
| 5 BK | 716. | 1.89 | 72.58 | .798 | 1.51 | 22.94 | .316 | 15.5 | 10.16 |
| 6 MIDS | 643. | 1.70 | 74.28 | 1.075 | 1.83 | 24.77 | .333 | 11.6 | 10.20 |
| B AND SD | 925. | 2.45 | 76.73 | 1.855 | 4.54 | 29.30 | .382 | 11.0 | 10.22 |

STR WT . . . . . STREAM WEIGHT (GRAMS/5 MINUTES
PCENT . . . . . PERCENT OF TOTAL PRODUCTS
S OF Q . . . . . SUM OF PERCENT OF TOTAL PRODUCTS
ASH . . . . . . PERCENT OF SAMPLE WEIGHT *
QXA . . . . . . (PERCENT OF TOTAL PRODUCTS) X (ASH)
S OF QXA . . . SUM OF QXA
CUM ASH . . . CUMULATIVE ASH (S OF QXA)/(S OF Q)
PROT . . . . . . PROTEIN, PERCENT OF SAMPLE WEIGHT *
CUM PROT . . . CUMULATIVE PROTEIN
* . . . . . . . 14 PERCENT MOISTURE BASIS

**** HRS-H YIELD=74.68 ****

| STREAM | STR WT | PCENT | S OF Q | ASH | QXA | S OF QXA | CUM ASH | PROT | CUM PROT |
|---|---|---|---|---|---|---|---|---|---|
| 1 MIDS B | 1720. | 4.45 | 4.45 | .238 | 1.06 | 1.06 | .238 | 11.7 | 11.72 |
| C SIZ B | 35. | .09 | 4.54 | .249 | .02 | 1.08 | .239 | 11.3 | 11.71 |
| 1 MIDS T | 2842. | 7.36 | 11.90 | .258 | 1.90 | 2.99 | .251 | 11.5 | 11.60 |
| 2 MIDS T | 4793. | 12.41 | 24.31 | .268 | 3.33 | 6.31 | .260 | 12.0 | 11.81 |
| 3 MIDS | 4906. | 12.70 | 37.02 | .277 | 3.52 | 9.84 | .266 | 12.4 | 12.01 |
| 2 MIDS B | 1528. | 3.96 | 40.97 | .278 | 1.10 | 10.94 | .267 | 12.0 | 12.01 |
| C SIZ T | 583. | 1.51 | 42.48 | .282 | .43 | 11.37 | .268 | 10.6 | 11.96 |
| F SIZ B | 122. | .32 | 42.80 | .289 | .09 | 11.46 | .268 | 12.1 | 11.96 |
| F SIZ T | 1335. | 3.46 | 46.25 | .319 | 1.10 | 12.56 | .272 | 12.4 | 11.99 |
| 4 MIDS | 2870. | 7.43 | 53.69 | .324 | 2.41 | 14.97 | .279 | 13.2 | 12.15 |
| 1,2,3 RED | 486. | 1.26 | 54.94 | .390 | .49 | 15.46 | .281 | 14.3 | 12.20 |
| 2 BK | 1003. | 2.60 | 57.54 | .447 | 1.16 | 16.62 | .289 | 14.9 | 12.33 |
| 3 BK | 941. | 2.44 | 59.98 | .450 | 1.10 | 17.72 | .295 | 15.9 | 12.47 |
| 2 QUAL | 221. | .57 | 60.55 | .456 | .26 | 17.98 | .297 | 12.0 | 12.47 |
| 5 MIDS | 992. | 2.57 | 63.12 | .472 | 1.21 | 19.19 | .304 | 13.0 | 12.49 |
| 1 BK | 683. | 1.77 | 64.89 | .480 | .85 | 20.04 | .309 | 15.0 | 12.56 |
| 4 BK | 607. | 1.57 | 66.46 | .507 | .80 | 20.83 | .313 | 17.5 | 12.67 |
| SUCTION | 81. | .21 | 66.67 | .540 | .11 | 20.95 | .314 | 12.8 | 12.67 |
| 1 TAILS | 266. | .69 | 67.36 | .591 | .41 | 21.36 | .317 | 12.4 | 12.67 |
| PRE BK | 19. | .05 | 67.41 | .614 | .03 | 21.39 | .317 | 13.5 | 12.67 |
| 5 BK | 618. | 1.60 | 69.01 | .652 | 1.04 | 22.43 | .325 | 19.1 | 12.82 |
| 6 MIDS | 1089. | 2.82 | 71.83 | .742 | 2.09 | 24.52 | .341 | 14.2 | 12.87 |
| B AND SD | 1102. | 2.85 | 74.68 | 1.476 | 4.21 | 28.73 | .385 | 15.9 | 12.99 |

STR WT . . . . . STREAM WEIGHT (GRAMS/5 MINUTES
PCENT . . . . . PERCENT OF TOTAL PRODUCTS
S OF Q . . . . . SUM OF PERCENT OF TOTAL PRODUCTS
ASH . . . . . . PERCENT OF SAMPLE WEIGHT *
QXA . . . . . . (PERCENT OF TOTAL PRODUCTS) X (ASH)
S OF QXA . . . SUM OF QXA
CUM ASH . . . CUMULATIVE ASH (S OF QXA)/(S OF Q)
PROT . . . . . . PROTEIN, PERCENT OF SAMPLE WEIGHT *
CUM PROT . . . CUMULATIVE PROTEIN
* . . . . . . . 14 PERCENT MOISTURE BASIS

**** GAINES    YIELD=77.03 ****

| STREAM | STR WT | PCENT | S OF Q | ASH | QXA | S OF QXA | CUM ASH | PROT | CUM PROT |
|---|---|---|---|---|---|---|---|---|---|
| 1 MIDS T | 2187. | 6.81 | 6.81 | .258 | 1.76 | 1.76 | .258 | 7.1 | 7.06 |
| 1 MIDS B | 2526. | 7.87 | 14.68 | .259 | 2.04 | 3.80 | .259 | 7.7 | 7.39 |
| 2 MIDS B | 1104. | 3.44 | 18.12 | .268 | .92 | 4.72 | .261 | 8.3 | 7.55 |
| C SIZ T | 442. | 1.38 | 19.49 | .269 | .37 | 5.09 | .261 | 6.4 | 7.47 |
| 2 MIDS T | 2865. | 8.92 | 28.41 | .269 | 2.40 | 7.49 | .264 | 7.9 | 7.60 |
| C SIZ B | 29. | .09 | 28.50 | .270 | .02 | 7.52 | .264 | 7.5 | 7.60 |
| F SIZ B | 95. | .30 | 28.80 | .279 | .08 | 7.60 | .264 | 7.7 | 7.60 |
| F SIZ T | 990. | 3.08 | 31.88 | .289 | .89 | 8.49 | .266 | 7.0 | 7.54 |
| 3 MIDS | 3335. | 10.39 | 42.27 | .298 | 3.09 | 11.58 | .274 | 8.5 | 7.78 |
| 2 BK | 1526. | 4.75 | 47.02 | .310 | 1.47 | 13.05 | .278 | 6.9 | 7.69 |
| 1 BK | 765. | 2.38 | 49.40 | .311 | .74 | 13.79 | .279 | 5.7 | 7.60 |
| 3 BK | 1113. | 3.47 | 52.87 | .319 | 1.10 | 14.90 | .282 | 8.1 | 7.63 |
| 1,2,3 RED | 1765. | 5.50 | 58.37 | .328 | 1.80 | 16.70 | .286 | 8.7 | 7.73 |
| 4 MIDS | 2583. | 8.04 | 66.41 | .357 | 2.87 | 19.57 | .295 | 9.6 | 7.96 |
| 4 BK | 425. | 1.32 | 67.73 | .368 | .49 | 20.06 | .296 | 9.0 | 7.98 |
| 2 QUAL | 145. | .45 | 68.19 | .378 | .17 | 20.23 | .297 | 7.6 | 7.98 |
| SUCTION | 79. | .25 | 68.43 | .421 | .10 | 20.33 | .297 | 15.3 | 8.00 |
| 1 TAILS | 202. | .63 | 69.06 | .426 | .27 | 20.60 | .298 | 7.6 | 8.00 |
| PRE BK | 57. | .18 | 69.24 | .459 | .08 | 20.68 | .299 | 6.8 | 8.00 |
| 5 MIDS | 505. | 1.57 | 70.81 | .484 | .76 | 21.44 | .303 | 8.8 | 8.02 |
| 5 BK | 636. | 1.98 | 72.79 | .524 | 1.04 | 22.48 | .309 | 11.7 | 8.11 |
| 6 MIDS | 350. | 1.09 | 73.88 | .906 | .99 | 23.47 | .318 | 11.0 | 8.16 |
| B AND SD | 1011. | 3.15 | 77.03 | .949 | 2.99 | 26.45 | .343 | 9.8 | 8.23 |

STR WT . . . . STREAM WEIGHT (GRAMS/5 MINUTES
PCENT . . . . PERCENT OF TOTAL PRODUCTS
S OF Q . . . . SUM OF PERCENT OF TOTAL PRODUCTS
ASH . . . . . PERCENT OF SAMPLE WEIGHT *
QXA . . . . . (PERCENT OF TOTAL PRODUCTS) X (ASH)
S OF QXA . . . SUM OF QXA
CUM ASH . . . CUMULATIVE ASH (S OF QXA)/(S OF Q)
PROT . . . . . PROTEIN, PERCENT OF SAMPLE WEIGHT *
CUM PROT . . . CUMULATIVE PROTEIN
* . . . . . . . 14 PERCENT MOISTURE BASIS

**** SRW YIELD=72.33 ****

| STREAM | STR WT | PCENT | S OF Q | ASH | QXA | S OF QXA | CUM ASH | PROT | CUM PROT |
|---|---|---|---|---|---|---|---|---|---|
| 1 MIDS T | 1229. | 3.59 | 3.59 | .210 | .75 | .75 | .210 | 8.7 | 8.70 |
| 1 MIDS B | 1510. | 4.42 | 8.01 | .230 | 1.01 | 1.77 | .221 | 10.1 | 9.47 |
| 2 MIDS B | 1203. | 3.52 | 11.53 | .230 | .81 | 2.58 | .224 | 11.3 | 10.02 |
| 2 MIDS T | 2213. | 6.47 | 18.00 | .240 | 1.56 | 4.13 | .230 | 10.4 | 10.16 |
| C SIZ T | 318. | .93 | 18.93 | .250 | .23 | 4.37 | .231 | 7.7 | 10.04 |
| 2 BK | 1852. | 5.42 | 24.35 | .253 | 1.37 | 5.74 | .236 | 8.0 | 9.59 |
| F SIZ T | 1333. | 3.90 | 28.25 | .261 | 1.02 | 6.75 | .239 | 9.2 | 9.54 |
| C SIZ B | 24. | .07 | 28.32 | .270 | .02 | 6.77 | .239 | 10.5 | 9.54 |
| 3 MIDS | 2547. | 7.45 | 35.76 | .270 | 2.01 | 8.78 | .246 | 11.4 | 9.93 |
| F SIZ B | 293. | .86 | 36.62 | .270 | .23 | 9.01 | .246 | 10.4 | 9.94 |
| 1 BK | 750. | 2.19 | 38.81 | .273 | .60 | 9.61 | .248 | 6.7 | 9.75 |
| 1,2,3 RED | 2613. | 7.64 | 46.46 | .281 | 2.15 | 11.76 | .253 | 10.5 | 9.88 |
| 3 BK | 1306. | 3.82 | 50.28 | .291 | 1.11 | 12.87 | .256 | 10.0 | 9.90 |
| 5 MIDS | 1264. | 3.70 | 53.97 | .307 | 1.14 | 14.01 | .260 | 10.9 | 9.96 |
| 4 MIDS | 1557. | 4.55 | 58.53 | .358 | 1.63 | 15.64 | .267 | 13.0 | 10.20 |
| 6 MIDS | 1659. | 4.85 | 63.38 | .376 | 1.83 | 17.47 | .276 | 12.9 | 10.41 |
| 2 QUAL | 133. | .39 | 63.77 | .378 | .15 | 17.62 | .276 | 7.7 | 10.39 |
| 4 BK | 533. | 1.56 | 65.33 | .391 | .61 | 18.23 | .279 | 12.5 | 10.44 |
| SUCTION | 290. | .85 | 66.17 | .394 | .33 | 18.56 | .280 | 12.4 | 10.47 |
| 1 TAILS | 333. | .97 | 67.15 | .408 | .40 | 18.96 | .282 | 8.4 | 10.44 |
| PRE BK | 30. | .09 | 67.24 | .476 | .04 | 19.00 | .283 | 8.7 | 10.44 |
| 5 BK | 600. | 1.75 | 68.99 | .538 | .94 | 19.94 | .289 | 14.8 | 10.55 |
| B AND SD | 1142. | 3.34 | 72.33 | 1.186 | 3.96 | 23.90 | .330 | 13.8 | 10.70 |

STR WT . . . . . STREAM WEIGHT (GRAMS/5 MINUTES
PCENT . . . . . PERCENT OF TOTAL PRODUCTS
S OF Q . . . . . SUM OF PERCENT OF TOTAL PRODUCTS
ASH . . . . . . PERCENT OF SAMPLE WEIGHT *
QXA . . . . . . (PERCENT OF TOTAL PRODUCTS) X (ASH)
S OF QXA . . . . SUM OF QXA
CUM ASH . . . . CUMULATIVE ASH (S OF QXA)/(S OF Q)
PROT . . . . . . PROTEIN, PERCENT OF SAMPLE WEIGHT *
CUM PROT . . . . CUMULATIVE PROTEIN
* . . . . . . . . 14 PERCENT MOISTURE BASIS

**** HRW-L YIELD=73.00 ****

| STREAM | STR WT | PCENT | S OF Q | ASH | QXA | S OF QXA | CUM ASH | PROT | CUM PROT |
|---|---|---|---|---|---|---|---|---|---|
| 1 MIDS B | 1287. | 3.19 | 3.19 | .273 | .87 | .87 | .273 | 9.4 | 9.41 |
| 1 MIDS T | 2361. | 5.84 | 9.03 | .275 | 1.61 | 2.48 | .274 | 9.0 | 9.12 |
| 3 MIDS | 3167. | 7.84 | 16.87 | .293 | 2.30 | 4.78 | .283 | 9.3 | 9.21 |
| 2 MIDS B | 1461. | 3.62 | 20.48 | .294 | 1.06 | 5.84 | .285 | 9.4 | 9.25 |
| C SIZ T | 635. | 1.57 | 22.05 | .294 | .46 | 6.30 | .286 | 8.3 | 9.18 |
| C SIZ B | 49. | .12 | 22.18 | .295 | .04 | 6.34 | .286 | 8.8 | 9.18 |
| F SIZ B | 266. | .66 | 22.83 | .295 | .19 | 6.53 | .286 | 9.1 | 9.18 |
| 2 MIDS T | 4380. | 10.84 | 33.67 | .296 | 3.21 | 9.74 | .289 | 9.4 | 9.24 |
| F SIZ T | 1794. | 4.44 | 38.11 | .304 | 1.35 | 11.09 | .291 | 9.2 | 9.24 |
| 1 BK | 1090. | 2.70 | 40.81 | .337 | .91 | 12.00 | .294 | 7.7 | 9.14 |
| 4 MIDS | 2487. | 6.16 | 46.97 | .343 | 2.11 | 14.11 | .300 | 10.4 | 9.30 |
| 2 BK | 1881. | 4.66 | 51.62 | .346 | 1.61 | 15.72 | .304 | 9.1 | 9.29 |
| 2 QUAL | 275. | .68 | 52.30 | .346 | .24 | 15.95 | .305 | 7.9 | 9.27 |
| 1,2,3 RED | 1259. | 3.12 | 55.42 | .347 | 1.08 | 17.03 | .307 | 9.6 | 9.29 |
| 5 MIDS | 1919. | 4.75 | 60.17 | .361 | 1.71 | 18.75 | .312 | 9.4 | 9.30 |
| 3 BK | 1620. | 4.01 | 64.18 | .386 | 1.55 | 20.29 | .316 | 11.4 | 9.43 |
| PRE BK | 100. | .25 | 64.43 | .395 | .10 | 20.39 | .317 | 8.0 | 9.42 |
| SUCTION | 114. | .28 | 64.71 | .425 | .12 | 20.51 | .317 | 9.9 | 9.42 |
| 1 TAILS | 273. | .68 | 65.38 | .435 | .29 | 20.81 | .318 | 8.1 | 9.41 |
| 4 BK | 556. | 1.38 | 66.76 | .514 | .71 | 21.51 | .322 | 13.5 | 9.50 |
| 6 MIDS | 906. | 2.24 | 69.00 | .542 | 1.22 | 22.73 | .329 | 9.5 | 9.50 |
| 5 BK | 609. | 1.51 | 70.51 | .806 | 1.21 | 23.94 | .340 | 15.7 | 9.63 |
| B AND SD | 1006. | 2.49 | 73.00 | 1.308 | 3.26 | 27.20 | .373 | 12.1 | 9.71 |

STR WT . . . . . STREAM WEIGHT (GRAMS/5 MINUTES
PCENT . . . . . PERCENT OF TOTAL PRODUCTS
S OF Q . . . . . SUM OF PERCENT OF TOTAL PRODUCTS
ASH . . . . . . PERCENT OF SAMPLE WEIGHT *
QXA . . . . . . (PERCENT OF TOTAL PRODUCTS) X (ASH)
S OF QXA . . . SUM OF QXA
CUM ASH . . . CUMULATIVE ASH (S OF QXA)/(S OF Q)
PROT . . . . . . PROTEIN, PERCENT OF SAMPLE WEIGHT *
CUM PROT . . . CUMULATIVE PROTEIN
* . . . . . . . . 14 PERCENT MOISTURE BASIS

**** HRW-H YIFLD=72.40 ****

| STREAM | STR WT | PCENT | S OF Q | ASH | QXA | S OF QXA | CUM ASH | PROT | CUM PROT |
|---|---|---|---|---|---|---|---|---|---|
| 1 MIDS B | 1690. | 4.26 | 4.26 | .283 | 1.20 | 1.20 | .283 | 11.2 | 11.20 |
| 1 MIDS T | 2590. | 6.52 | 10.78 | .293 | 1.91 | 3.11 | .289 | 10.6 | 10.84 |
| 2 MIDS B | 1325. | 3.34 | 14.11 | .303 | 1.01 | 4.12 | .292 | 11.8 | 11.07 |
| 2 MIDS T | 4000. | 10.07 | 24.19 | .311 | 3.14 | 7.26 | .300 | 11.6 | 11.27 |
| C SIZ B | 54. | .14 | 24.32 | .313 | .04 | 7.30 | .300 | 11.1 | 11.27 |
| F SIZ B | 328. | .83 | 25.15 | .314 | .26 | 7.56 | .301 | 11.3 | 11.27 |
| C SIZ T | 740. | 1.86 | 27.01 | .323 | .60 | 8.16 | .302 | 10.9 | 11.25 |
| F SIZ T | 1925. | 4.85 | 31.86 | .323 | 1.57 | 9.73 | .305 | 11.3 | 11.26 |
| 3 MIDS | 3100. | 7.81 | 39.66 | .329 | 2.57 | 12.30 | .310 | 11.6 | 11.32 |
| 4 MIDS | 2865. | 7.21 | 46.88 | .358 | 2.59 | 14.88 | .318 | 12.5 | 11.51 |
| 1,2,3 RED | 833. | 2.10 | 48.98 | .383 | .80 | 15.69 | .320 | 14.4 | 11.63 |
| 2 QUAL | 242. | .61 | 49.59 | .400 | .24 | 15.93 | .321 | 11.1 | 11.62 |
| 2 BK | 1415. | 3.56 | 53.15 | .411 | 1.47 | 17.40 | .327 | 14.1 | 11.79 |
| 3 BK | 1405. | 3.54 | 56.69 | .426 | 1.51 | 18.90 | .333 | 15.6 | 12.03 |
| 5 MIDS | 1660. | 4.18 | 60.87 | .448 | 1.87 | 20.78 | .341 | 12.0 | 12.03 |
| 1 BK | 907. | 2.28 | 63.15 | .456 | 1.04 | 21.82 | .346 | 13.9 | 12.09 |
| SUCTION | 192. | .48 | 63.63 | .465 | .22 | 22.05 | .346 | 11.7 | 12.09 |
| 4 BK | 607. | 1.53 | 65.16 | .522 | .80 | 22.84 | .351 | 18.1 | 12.23 |
| PRE BK | 82. | .21 | 65.37 | .525 | .11 | 22.95 | .351 | 14.1 | 12.24 |
| 1 TAILS | 324. | .82 | 66.19 | .532 | .43 | 23.39 | .353 | 11.3 | 12.23 |
| 6 MIDS | 839. | 2.11 | 68.30 | .639 | 1.35 | 24.74 | .362 | 12.2 | 12.23 |
| 5 BK | 635. | 1.60 | 69.90 | .753 | 1.20 | 25.94 | .371 | 19.9 | 12.40 |
| B AND SD | 994. | 2.50 | 72.40 | 1.403 | 3.51 | 29.45 | .407 | 16.3 | 12.54 |

STR WT . . . . . STREAM WEIGHT (GRAMS/5 MINUTES
PCENT . . . . . PERCENT OF TOTAL PRODUCTS
S OF Q . . . . . SUM OF PERCENT OF TOTAL PRODUCTS
ASH . . . . . . PERCENT OF SAMPLE WEIGHT *
QXA . . . . . . (PERCENT OF TOTAL PRODUCTS) X (ASH)
S OF QXA . . . SUM OF QXA
CUM ASH . . . CUMULATIVE ASH (S OF QXA)/(S OF Q)
PROT . . . . . PROTEIN, PERCENT OF SAMPLE WEIGHT *
CUM PROT . . . CUMULATIVE PROTEIN
* . . . . . . . 14 PERCENT MOISTURE BASIS

**** HRW-1 YIELD=75.82 ****

| STREAM | STR WT | PCENT | S OF Q | ASH | QXA | S OF QXA | CUM ASH | PROT | CUM PROT |
|---|---|---|---|---|---|---|---|---|---|
| 1 MIDS T | 3747. | 9.61 | 9.61 | .269 | 2.59 | 2.59 | .269 | 9.4 | 9.38 |
| F SIZ B | 52. | .13 | 9.74 | .299 | .04 | 2.63 | .270 | 10.4 | 9.39 |
| 2 MIDS B | 1067. | 2.74 | 12.48 | .300 | .82 | 3.45 | .276 | 9.9 | 9.51 |
| 1 MIDS B | 1195. | 3.07 | 15.55 | .301 | .92 | 4.37 | .281 | 9.6 | 9.53 |
| F SIZ T | 773. | 1.98 | 17.53 | .303 | .60 | 4.97 | .284 | 9.2 | 9.49 |
| 3 MIDS | 4420. | 11.34 | 28.87 | .310 | 3.51 | 8.49 | .294 | 10.4 | 9.85 |
| C SIZ T | 925. | 2.37 | 31.24 | .310 | .74 | 9.22 | .295 | 10.0 | 9.86 |
| 2 MIDS T | 5040. | 12.93 | 44.16 | .311 | 4.02 | 13.24 | .300 | 9.7 | 9.82 |
| C SIZ B | 55. | .14 | 44.31 | .331 | .05 | 13.29 | .300 | 9.6 | 9.82 |
| 4 MIDS | 2143. | 5.50 | 49.80 | .349 | 1.92 | 15.21 | .305 | 11.0 | 9.95 |
| 1,2,3 RED | 745. | 1.91 | 51.71 | .353 | .67 | 15.88 | .307 | 10.0 | 9.95 |
| 2 BK | 1379. | 3.54 | 55.25 | .374 | 1.32 | 17.20 | .311 | 10.2 | 9.96 |
| 3 BK | 1333. | 3.42 | 58.67 | .383 | 1.31 | 18.51 | .316 | 11.7 | 10.07 |
| 1 BK | 1035. | 2.65 | 61.32 | .384 | 1.02 | 19.53 | .319 | 9.4 | 10.04 |
| 2 QUAL | 290. | .74 | 62.07 | .399 | .30 | 19.83 | .319 | 10.0 | 10.04 |
| 5 MIDS | 1868. | 4.79 | 66.86 | .406 | 1.95 | 21.78 | .326 | 10.7 | 10.08 |
| 4 BK | 590. | 1.51 | 68.37 | .432 | .65 | 22.43 | .328 | 12.9 | 10.15 |
| 1 TAILS | 388. | 1.00 | 69.37 | .451 | .45 | 22.88 | .330 | 9.9 | 10.14 |
| PRE BK | 70. | .18 | 69.55 | .490 | .09 | 22.97 | .330 | 9.3 | 10.14 |
| SUCTION | 75. | .19 | 69.74 | .504 | .10 | 23.06 | .331 | 10.4 | 10.14 |
| 5 BK | 703. | 1.80 | 71.54 | .587 | 1.06 | 24.12 | .337 | 15.4 | 10.27 |
| 6 MIDS | 773. | 1.98 | 73.52 | .805 | 1.60 | 25.72 | .350 | 11.7 | 10.31 |
| B AND SD | 895. | 2.30 | 75.82 | 1.190 | 2.73 | 28.45 | .375 | 13.0 | 10.39 |

STR WT . . . . . STREAM WEIGHT (GRAMS/5 MINUTES
PCENT . . . . . PERCENT OF TOTAL PRODUCTS
S OF Q . . . . . SUM OF PERCENT OF TOTAL PRODUCTS
ASH . . . . . . PERCENT OF SAMPLE WEIGHT *
QXA . . . . . . (PERCENT OF TOTAL PRODUCTS) X (ASH)
S OF QXA . . . SUM OF QXA
CUM ASH . . . . CUMULATIVE ASH (S OF QXA)/(S OF Q)
PROT . . . . . . PROTEIN, PERCENT OF SAMPLE WEIGHT *
CUM PROT . . . CUMULATIVE PROTEIN
* . . . . . . . 14 PERCENT MOISTURE BASIS

**** HRW-2 YIELD=74.57 ****

| STREAM | STR WT | PCENT | S OF Q | ASH | QXA | S OF QXA | CUM ASH | PROT | CUM PROT |
|---|---|---|---|---|---|---|---|---|---|
| 1 MIDS B | 2025. | 4.86 | 4.86 | .272 | 1.32 | 1.32 | .272 | 9.9 | 9.88 |
| 1 MIDS T | 3409. | 8.18 | 13.04 | .281 | 2.30 | 3.62 | .278 | 9.6 | 9.73 |
| F SIZ B | 82. | .20 | 13.23 | .291 | .06 | 3.68 | .278 | 9.7 | 9.73 |
| 2 MIDS T | 4123. | 9.89 | 23.13 | .291 | 2.88 | 6.56 | .284 | 10.0 | 9.86 |
| 2 MIDS B | 1387. | 3.33 | 26.45 | .291 | .97 | 7.53 | .285 | 9.8 | 9.86 |
| 3 MIDS | 4609. | 11.06 | 37.51 | .309 | 3.41 | 10.94 | .292 | 10.3 | 9.98 |
| C SIZ B | 31. | .07 | 37.59 | .309 | .02 | 10.96 | .292 | 10.0 | 9.98 |
| F SIZ T | 1250. | 3.00 | 40.59 | .313 | .94 | 11.90 | .293 | 9.9 | 9.97 |
| C SIZ T | 596. | 1.43 | 42.02 | .321 | .46 | 12.36 | .294 | 10.4 | 9.98 |
| 1,2,3 RED | 916. | 2.20 | 44.21 | .335 | .74 | 13.10 | .296 | 10.3 | 10.00 |
| 2 BK | 1642. | 3.94 | 48.15 | .336 | 1.32 | 14.42 | .299 | 10.5 | 10.04 |
| 1 BK | 822. | 1.97 | 50.12 | .355 | .70 | 15.12 | .302 | 9.3 | 10.01 |
| 4 MIDS | 3342. | 8.02 | 58.14 | .357 | 2.86 | 17.98 | .309 | 11.1 | 10.16 |
| 3 BK | 1529. | 3.67 | 61.81 | .384 | 1.41 | 19.39 | .314 | 12.2 | 10.28 |
| PRE BK | 27. | .06 | 61.88 | .449 | .03 | 19.42 | .314 | 9.4 | 10.28 |
| SUCTION | 122. | .29 | 62.17 | .465 | .14 | 19.56 | .315 | 10.8 | 10.29 |
| 4 BK | 468. | 1.12 | 63.29 | .469 | .53 | 20.08 | .317 | 13.6 | 10.34 |
| 5 MIDS | 1371. | 3.29 | 66.58 | .502 | 1.65 | 21.74 | .326 | 10.9 | 10.37 |
| 2 QUAL | 246. | .59 | 67.17 | .536 | .32 | 22.05 | .328 | 10.2 | 10.37 |
| 1 TAILS | 276. | .66 | 67.83 | .621 | .41 | 22.46 | .331 | 10.2 | 10.37 |
| 5 BK | 628. | 1.51 | 69.34 | .687 | 1.03 | 23.50 | .339 | 15.6 | 10.48 |
| 6 MIDS | 1013. | 2.43 | 71.77 | .783 | 1.90 | 25.40 | .354 | 11.7 | 10.53 |
| B AND SD | 1167. | 2.80 | 74.57 | 1.481 | 4.15 | 29.55 | .396 | 13.9 | 10.65 |

STR WT . . . . . STREAM WEIGHT (GRAMS/5 MINUTES
PCENT . . . . . PERCENT OF TOTAL PRODUCTS
S OF Q . . . . . SUM OF PERCENT OF TOTAL PRODUCTS
ASH . . . . . . PERCENT OF SAMPLE WEIGHT *
QXA . . . . . . (PERCENT OF TOTAL PRODUCTS) X (ASH)
S OF QXA . . . . SUM OF QXA
CUM ASH . . . . CUMULATIVE ASH (S OF QXA)/(S OF Q)
PROT . . . . . . PROTEIN, PERCENT OF SAMPLE WEIGHT *
CUM PROT . . . . CUMULATIVE PROTEIN
* . . . . . . . 14 PERCENT MOISTURE BASIS

**** HRW-3 YIELD=74.95 ****

| STREAM | STR WT | PCENT | S OF Q | ASH | QXA | S OF QXA | CUM ASH | PROT | CUM PROT |
|---|---|---|---|---|---|---|---|---|---|
| 1 MIDS B | 1891. | 4.81 | 4.81 | .282 | 1.36 | 1.36 | .282 | 9.8 | 9.78 |
| 2 MIDS T | 4569. | 11.61 | 16.42 | .291 | 3.38 | 4.74 | .288 | 9.8 | 9.32 |
| 1 MIDS T | 3306. | 8.40 | 24.82 | .292 | 2.45 | 7.19 | .290 | 9.5 | 9.70 |
| C SIZ B | 23. | .06 | 24.87 | .292 | .02 | 7.20 | .290 | 9.4 | 9.69 |
| 3 MIDS | 4073. | 10.35 | 35.22 | .310 | 3.21 | 10.41 | .296 | 10.0 | 9.79 |
| F SIZ B | 84. | .21 | 35.44 | .310 | .07 | 10.48 | .296 | 9.7 | 9.79 |
| 2 MIDS B | 1370. | 3.48 | 38.92 | .312 | 1.09 | 11.57 | .297 | 9.8 | 9.79 |
| C SIZ T | 669. | 1.70 | 40.62 | .312 | .53 | 12.10 | .298 | 9.6 | 9.78 |
| F SIZ T | 871. | 2.21 | 42.83 | .321 | .71 | 12.81 | .299 | 9.7 | 9.77 |
| 4 MIDS | 2232. | 5.67 | 48.50 | .340 | 1.93 | 14.74 | .304 | 10.6 | 9.87 |
| 1,2,3 RED | 845. | 2.15 | 50.65 | .355 | .76 | 15.50 | .306 | 10.6 | 9.90 |
| 2 BK | 1554. | 3.95 | 54.60 | .375 | 1.48 | 16.98 | .311 | 10.8 | 9.97 |
| 1 BK | 902. | 2.29 | 56.89 | .395 | .91 | 17.89 | .314 | 9.9 | 9.96 |
| 1 TAILS | 303. | .77 | 57.66 | .400 | .31 | 18.19 | .316 | 9.7 | 9.96 |
| 3 BK | 1636. | 4.16 | 61.82 | .415 | 1.72 | 19.92 | .322 | 13.0 | 10.16 |
| 5 MIDS | 1665. | 4.23 | 66.05 | .419 | 1.77 | 21.69 | .328 | 10.1 | 10.15 |
| 2 QUAL | 298. | .76 | 66.81 | .478 | .36 | 22.05 | .330 | 9.8 | 10.15 |
| SUCTION | 88. | .22 | 67.03 | .526 | .12 | 22.17 | .331 | 10.6 | 10.15 |
| PRE BK | 56. | .14 | 67.17 | .547 | .08 | 22.25 | .331 | 9.1 | 10.15 |
| 4 BK | 570. | 1.45 | 68.62 | .554 | .80 | 23.05 | .336 | 15.3 | 10.26 |
| 6 MIDS | 1119. | 2.84 | 71.46 | .703 | 2.00 | 25.05 | .350 | 10.5 | 10.27 |
| 5 BK | 476. | 1.21 | 72.67 | .772 | .93 | 25.98 | .358 | 16.4 | 10.37 |
| 8 AND SD | 896. | 2.28 | 74.95 | 1.387 | 3.16 | 29.14 | .389 | 13.5 | 10.46 |

STR WT . . . . . STREAM WEIGHT (GRAMS/5 MINUTES  
PCENT . . . . . PERCENT OF TOTAL PRODUCTS  
S OF Q . . . . . SUM OF PERCENT OF TOTAL PRODUCTS  
ASH . . . . . . PERCENT OF SAMPLE WEIGHT *  
QXA . . . . . . (PERCENT OF TOTAL PRODUCTS) X (ASH)  
S OF QXA . . . . SUM OF QXA  
CUM ASH . . . . CUMULATIVE ASH (S OF QXA)/(S OF Q)  
PROT . . . . . . PROTEIN, PERCENT OF SAMPLE WEIGHT *  
CUM PROT . . . . CUMULATIVE PROTEIN  
* . . . . . . . 14 PERCENT MOISTURE BASIS

## APPENDIX C

INDIVIDUAL FLOUR STREAM WEIGHTS FROM SEVERAL HARD RED WINTER WHEATS, PERCENT OF TOTAL PRODUCTS

FLOUR STREAMS, K.S.U. PILOT FLOUR MILL, PERCENT OF TOTAL PRODUCT

| | Wheat Mix | | | | | |
|---|---|---|---|---|---|---|
| Flour Stream | HRW-L | | HRW-H | | HRW | Mean |
| Pre Bk | .247 | .231 | .226 | .206 | .101 | .131 |
| 1 Bk | 2.697 | 2.717 | 2.298 | 2.283 | 2.496 | 2.422 |
| 2 Bk | 4.655 | 4.829 | 3.341 | 3.563 | 3.523 | 3.869 |
| 3 Bk | 4.009 | 4.183 | 3.535 | 3.537 | 3.911 | 3.739 |
| 1,2,3 Red | 3.116 | 3.269 | 2.183 | 2.097 | 1.580 | 2.178 |
| C Siz T | 1.571 | 1.577 | 1.901 | 1.863 | 1.511 | 1.849 |
| C Siz B | .121 | .124 | .129 | .135 | .088 | .108 |
| F Siz T | 4.440 | 4.441 | 4.986 | 4.847 | 2.356 | 2.950 |
| F Siz B | .658 | .690 | .895 | .825 | .140 | .340 |
| 1 Mids T | 5.843 | 5.859 | 6.482 | 6.521 | 11,809 | 8.318 |
| 1 Mids B | 3.185 | 3.517 | 4.235 | 4.255 | 2.890 | 3.914 |
| 2 Mids T | 10.840 | 10.939 | 9.710 | 10.072 | 13.791 | 11.480 |
| 2 Mids B | 3.615 | 3.591 | 2.995 | 3.336 | 2.499 | 3.123 |
| 2 Qual | .680 | .688 | .542 | .609 | .467 | .693 |
| 4 Bk | 1.376 | 1.301 | 1.542 | 1.528 | 1.805 | 1.402 |
| 3 Mids | 7.838 | 7.566 | 7.597 | 7.806 | 11.704 | 10.031 |
| 1 Tails | .675 | .740 | .542 | .815 | .856 | .818 |
| 4 Mids | 6.155 | 6.257 | 7.869 | 7.214 | 5.056 | 6.473 |
| Suction | .282 | .365 | .430 | .483 | .132 | .330 |
| 5 Bk | 1.507 | 1.264 | 1.318 | 1.598 | 2.171 | 1.501 |
| 5 Mids | 4.749 | 4.789 | 4.245 | 4.180 | 3.347 | 4.162 |
| B and SD | 2.489 | 2.056 | 2.949 | 2.502 | 2.543 | 2.475 |
| 6 Mids | 2.242 | 1.997 | 2.428 | 2.112 | 2.114 | 2.304 |

FLOUR STREAMS, K.S.U. PILOT FLOUR MILL, PERCENT OF TOTAL PRODUCT

| Flour Stream | Wheat Mix | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | HRW-1 | | | | HRW-2 | | | HRW-3 | | Mean |
| Pre Bk | .017 | .180 | .012 | .179 | .071 | .064 | .076 | .075 | .142 | .131 |
| 1 Bk | 2.793 | 2.500 | 2.727 | 2.653 | 2.021 | 1.972 | 2.162 | 2.291 | 2.293 | 2.422 |
| 2 Bk | 3.527 | 3.542 | 3.427 | 3.536 | 3.967 | 3.941 | 4.025 | 4.333 | 3.951 | 3.869 |
| 3 Bk | 3.463 | 3.370 | 3.468 | 3.418 | 3.654 | 3.669 | 3.771 | 4.187 | 4.159 | 3.739 |
| 1,2,3 Red | 1.903 | 1.740 | 1.803 | 1.910 | 2.248 | 2.198 | 2.263 | 2.036 | 2.148 | 2.178 |
| C Siz T | 2.411 | 2.490 | 2.362 | 2.371 | 1.453 | 1.430 | 1.467 | 1.782 | 1.701 | 1.849 |
| C Siz B | .143 | .152 | .128 | .141 | .076 | .074 | .079 | .065 | .058 | .108 |
| F Siz T | 1.700 | 1.677 | 1.695 | 1.982 | 3.010 | 3.000 | 3.001 | 1.956 | 2.214 | 2.950 |
| F Siz B | .153 | .182 | .133 | .133 | .233 | .196 | .221 | .090 | .213 | .340 |
| 1 Mids T | 9.800 | 9.813 | 9.503 | 9.608 | 8.331 | 8.182 | 8.256 | 8.044 | 8.406 | 8.318 |
| 1 Mids B | 3.032 | 3.067 | 2.920 | 3.064 | 5.012 | 4.860 | 5.161 | 4.786 | 4.808 | 3.914 |
| 2 Mids T | 13.089 | 13.110 | 13.307 | 12.923 | 9.729 | 9.895 | 9.877 | 11.826 | 11.617 | 11.480 |
| 2 Mids B | 2.491 | 2.800 | 2.663 | 2.735 | 3.267 | 3.329 | 3.352 | 3.562 | 3.483 | 3.123 |
| 2 Qual | .800 | .967 | .800 | .742 | .537 | .590 | .565 | .953 | .757 | .693 |
| 4 Bk | 1.385 | 1.437 | 1.469 | 1.512 | 1.152 | 1.123 | 1.125 | 1.427 | 1.449 | 1.402 |
| 3 Mids | 11.044 | 11.125 | 11.374 | 11.333 | 11.353 | 11.062 | 9.824 | 10.453 | 10.356 | 10.031 |
| 1 Tails | 1.180 | 1.050 | .980 | .994 | .699 | .662 | .610 | .873 | .770 | .818 |
| 4 Mids | 6.041 | 5.462 | 5.612 | 5.495 | 7.863 | 8.021 | 8.176 | 5.725 | 5.675 | 6.473 |
| Suction | .461 | .437 | .347 | .192 | .451 | .292 | .353 | .173 | .223 | .330 |
| 5 Bk | 1.439 | 1.467 | 1.430 | 1.802 | 1.594 | 1.507 | 1.594 | 1.115 | 1.210 | 1.501 |
| 5 Mids | 4.656 | 4.840 | 5.085 | 4.789 | 2.711 | 3.290 | 3.090 | 4.270 | 4.233 | 4.162 |
| B and SD | 2.296 | 2.250 | 2.349 | 2.294 | 2.685 | 2.801 | 2.902 | 2.253 | 2.278 | 2.475 |
| 6 Mids | 1.965 | 2.132 | 2.192 | 1.982 | 2.470 | 2.431 | 2.640 | 2.714 | 2.845 | 2.304 |

# THE DISTRIBUTION AND ANALYSIS OF ALL THE STREAMS ON THE KANSAS STATE UNIVERSITY PILOT FLOUR MILL

by

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AN ABSTRACT OF A MASTER'S THESIS

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requirements for the degree

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1967

This study investigated quantitatively the distributions of stock of several different wheats to and from each milling machine in a production scale flour mill to collect data that would be useful in evaluating milling systems and in designing new mills. One hundred thirteen samples were collected and analyzed while milling one lot of each class of wheat.

Nine samples of wheat from four classes were milled on the Kansas State University Pilot Flour Mill. Five of the samples were hard red winter wheats, two were hard red spring wheats, one was a soft red winter, and one was a soft white wheat. Each wheat sample was milled in test for 9-12 hours.

Samples of every stream in the pilot flour mill were collected for five minute periods while the spring wheats or the soft wheats were being milled. The samples were weighed and each was analyzed for moisture, ash, and protein. Data from a 1964 report[1] on the milling of hard red winter wheats were used here. In this study the individual flour streams and the millfeed streams from the five hard red winter wheats were collected and analyzed.

Care was taken to duplicate the temperature and relative humidity of the air in the mill when milling each sample. It was necessary to mill the soft wheats more slowly and at a lower moisture than the hard wheats. The same break release schedule was used for all the wheats. The only change in the break system was made in the break redust sifter section where two flour cloths with larger openings than usual were added when milling the

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[1]E. P. Farrell and A. B. Ward. Flow rates and analyses for ash and protein of all streams in the Kansas State University pilot mill. Association of Operative Millers Bul., March, 1964, pp. 2842-2847.

soft wheats. Coarser sifter clothing was installed in the third and fourth middlings sifters for use when milling Gaines and the two hard red spring wheats. The need for this was shown by the results of the milling of soft red winter wheat.

Throughout the mill the distribution of stock from both classes of hard wheat milled were similar except that the hard red spring wheat made slightly less break flour and more coarse middlings. This indicated that the spring wheat was harder to reduce than the winter wheat because of the generally stronger nature of the spring wheat endosperm. The break granulation curves from both classes of hard wheats were fairly straight and could be approximated by a straight line for design purposes.

The soft wheats performed on the mill quite differently than the hard wheats. The endosperm of the soft wheats reduced much more easily but sifted more slowly than that from either of the hard wheat classes. The granulation curves of the break stocks obtained from the soft wheats were more concave than those from the hard wheats. A straight line does not give a satisfactory approximation of the granulation of ground break stocks from soft wheat.

The cumulative ash curves obtained from the four classes of wheat showed no grouping along class lines or between hard and soft wheats.

The flow weights of the individual flour streams showed consistency for a given wheat but varied over a much wider range when comparing one wheat with another. The flour stream weights from all the hard red winter wheats were used to calculate a mean and standard deviation for the flour production of every flour stream in the pilot mill. These data will be of value in future tests on the Kansas State University Pilot Flour Mill to determine the feasibility of controlling the mill by flour production alone.