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ADVANTAGES OF MILLING WITH A LOW PERCENTAGE OF HULLS AND OTHER FOREIGN MATTER.

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Summary. This paper is about a study of the great differences existing between methods employed in the preparation of sunflower grains, previous to milling. Many important mills - and that in technically developed countries - do not decorticate and sometimes - we have heard - do not even clean the grains. Others do decorticate, with various degrees of efficiency. In the Western world, as far as we know, about 16 and 20 percent are the minimum and maximum Hull contents, in those mills that do decorticate. Our group understands that - for best quality Oil and Meal production and lower unit costs - the ideal milling should be done with pure Kernels, free of any Foreign Matter (F.M.). Naturally,this concept defines Hulls also as F.M. Also, we know this ideal is very difficult to attain, from a technical point of view. In this Paper we shall try to show the substantial advantages that can be achieved (in production capacity, quality of products., costs, etc); all this simply through reducing the percentage of F.M. (including Hulls) in the Kernels to be milled.

Resúmen (Español). Este trabajo es un estudio de las grandes diferencias existentes entre los métodos que se emplean, en la preparación de los granos de girasol, previo a su molienda. Muchos molinos importantes -y ellos en países tecnológicamente desarrollados- no descascaran y hasta a veces, según hemos oido, ni siquiera limpian la semilla. Otros sí descascaran, con variados grados de eficiencia; según nuestra información 16 y 20 % serían los porcientos mínimo y máximo logrados, aproximadamente, en el mundo Occidental, de cáscaras mezcladas con las Pepas a elaboración. Nuestro grupo de trabajo entiende que -para obtener Aceites y Harinas de la mejor calidad y a los menores costos- la molienda - ideal sería con pepas puras, libres de cualquier Cuerpo Extraño (C.E.). Naturalmente, este concepto involucra a las Cáscaras en la designación de C.E. Entendemos, además, que el concepto mencionado, si bien real, presenta una serie de dificultades tecnológicas no fáciles de superar.

Introduction. A number of years ago, our technical group started observing sunflower milling and wondering about the effect of such a large percent of F.M. (including Hulls, we repeat) in the process and in the quantity and quality of the products obtained. For a start, it became apparent that Hulls, due to their very low specific weight -and consequent high Volume relative to that of dry Pulp, Oil and H20 (the components of Cake together with Hulls) occupy a very important part of space in the machinery, and so reduce milling capacity. Further calculations and testing prooved that the increase in production when decreasing Hulls, was far above the percentage of Hull reduction. The reason became apparent: The Hulls, in whatever percentages, pass through the process without relatively altering their Volume. Whereas Kernels shed their Oil and consequently their Volume becomes less. When reducing Hull content and substituting Kernels you obtain a multiplying

effect, that results in production capacity increases of surprising amounts. The Table in page 6 shows a number of relevant variables, related to Hull percentage values.

Materials and Methods. We will first give the composition of the Grains and grain components we have chosen as typical. They correspond to a typical South American grain. It may be said here that results do not vary greatly if another typical grain is chosen: the advantages obtained from reducing Hulls are of such a magnitude, they can admit relative variations without altering the basis of this work.

Composition of grain chosen

Kernel : 70 % (weight)
Hulls : 30 % "
Protein (dry): 14 %

Kernel

Oil : 59 %
Dry Pulp: 36 %
H20 : 5 %
Protein : 20 %

Dry Pulp

Fiber : 8 %
Spec.weight: 1,3 (kG/dM3)
Protein :55,55 %

Meal

Oil : 1 %
H20 :12 %

Hull

Fiber : 60 %
Spec. weight: 0,6 (kG/dM3) (a dM3 of solid Hull material)
Humidity when entering process : 8 %
Protein : 3-4 %

Oil

Spec.weight : 0,9 (kG/dM3)

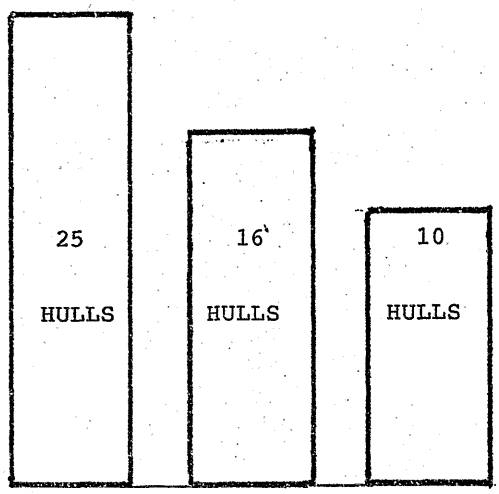
Cake Composition: Dry Pulp plus dry Hulls plus 15 % Oil plus 6,5 % H20

Our industrial tests have shown that the milling capacity of a given mill is determined by the Volume of Cake the solvent extractor is capable of processing, with reasonable efficiency. So, for milling capacity calculation, the problem is reduced to determining the Volume of Cake, for a constant weight of Kernels, and variable percentages of Hulls. Such is the method employed to calculate the figures in the Table on page 6.
Note: It must be said here that the Volumes calculated correspond to atmospheric pressure, because of the obvious difficulty of determining pressures inside the presses.
We shall now give an example of calculation of Cake volume, in accordande to the compositions and data given previously. So:

Taking 100 units of Kernels, we shall have, for the Cake composition, 36 units of dry Pulp. Lets, for example choose 10 % of Hulls, which would be 11,1 units. But, we need dry so we multiply by 0,92 and so have 10,22 dry Hulls. (please note we are calculating up to two decimal points). So, to form the Cake we add these two weights, and then add 21,5 %, corresponding to 15 % Oil and

6,5 % H20.

With this method it is simple to calculate the weight of Cakes corresponding to 100 units of Kernel (or any other fixed value chosen), and different percentages of Hulls.
But, as mentioned previously, we need Cake Volumes to determine milling capacity. The weights and proportions of products in the Cake mentioned above and the specific weights make easy to arrive at Volume values. Next, we show in graphic form the calculated Volumes of three different Cakes corresponding to three Hull percentages: 25 % (typical U.S.A. seed, non-decorticated); 16 % (aproximate minimum with typical western world equipment); and 10 % (a percentage we feel can well be hoped for). Please note the three Volumes shown graphically, correspond to identical Kernel weights, of identical seed tonnage. If, for example, a mill were working at full capacity with 25 % Hulls and a given tonnage, and you suddenly substituted with a 10 % Hull mix (and the same tonnage) the presses and extractor would start to empty. To fill them to capacity it would be necessary to increase the load (always with the 10 % Hull mix) until the previous Volume (for 25%) were reached. The Table in page 6, gives de Volume for different percentage Hulls and the calculated tonnage increases relative to Hull content In the Table are also given other data of interest to the mill operator, as weight of Meal (supposing a 1 % Oil content and 12 % H20); Protein and Fiber in Meal;etc;. All these variables, relative to Hull percentage and in accordance to the typical values given previously for the grain, Hulls and Kernels chosen.



Results. Briefly, we shall mention a series of important advantages that derive from the simple fact of reducing - as much as possible- the percentage of F.M. (including Hulls) that are milled together with the Kernels. Previously, we find it convenient to again remark the fact that the Volume of Cake entering the extractor is constant in all our reasoning (it's composition, is the variable). With a constant Volume of Cake it follows that most other milling variables are approximately constant too, such as steam, solvent, energy consumption, etc; and also labor. In other words the mill, from the laminating rolls onwards, needs no alteration whatsoever. The only addition is an efficient decorticating and Hull separating equipment, and the machinery for the handling of an increased tonnage of grain. And considering the -we dare say-

remarkable advantages obtained, from both the technical (quality of products) and commercial (much higher capacity, lower costs; among others) points of view such additions should be very modest indeed, as compared to the great investment a complete oil mill represents.
A mention of the more important results:

1 - Important increases in the milling capacity of a given mill, much larger than the reduction in Hull percentages.

2 - The capacity increases mentioned are obtained, we repeat,with a constant Volume of Cake, which means also (in general terms) no change in solvent, steam, energy, labour, etc. This obviously means a reduction in fixed costs proportional to the capacity increase: no mean matter in a competitive market; probably the most important factor from a commercial standpoint.

3 - An improvement in oil quality, because of less Hull wax in the tanks; also smaller settlings.

4 - The possibility of commercializing larger tonnages of Meal for the formulation of feed for chicks. This, due to the reduction in the Meals of Fiber and Lignine percentages, both largely present in Hulls.

5 - The system proposed here,implies the constant emergence from the solvent extractor of the highest quality of Meal (High Protein; low Fiber and Lignine). But market conditions maybe are not yet prepared for this high quality product. The installation of a simple regulatable feeder, which would add Hulls to the Meal after the solvent extractor and before pelleting, would allow the commercializing of diverse quality Meals;from the purest obtainable, to that corresponding to no-decortication; and this through the simple turning of a knob. Please note that this can be achieved and still enjoy the advantages of the higher production, lower costs, etc.

6 - When crushing with a low Hull percentage, naturally the weight of Meal per ton of grain emerging from the extractor decreases, but it is interesting to note that it decreases at a lower rate than the decrease in Hull percentage. This because the Hulls eliminated are substituted mainly by dry Pulp,with a specific weight more than double that of Hulls. When producing high quality Meals, pellet storage capacity consequently increases. Described in another way, production of pellets will have the same Volume, but their specific relative weight will be more,than the decrease in Hull percentage.

7 - As the important percentual increases in production are obtained with the same Volume of Meal, the Oil that goes with the Meal is approximately the same, which as a consequence, leaves and added tonnage of oil free for selling.

8 - The increase in specific weight of high quality Meals,(mentioned above in 6) would also permit savings in transport, as it would allow more Protein tonnage to be stowed in a given truck or ship.

9 - Decorticating frees important tonnages of Hulls, and often the question arises: "What to do with the extra Hulls?" The first,

the obvious answer is: "The same as before". That is, add the amount of Hulls you milled before to the Meal, but after the solvent extractor. In other words: Do not mill Hulls. Use them but dont' mill them. In those mills which today dont' decorticate, the problem is solved simply as above. They can continue commercializing low quality Meals,but enjoy a huge increase in capacity and corresponding low costs. Those mills who choose to commercialize higher quality Meals will, in fact, have a Hull surplus. In Argentina, Uruguay and other countries these Hulls are used as a very efficient fuel. As a fuel, Hulls are non-polluting, permanently renewable, produced at the mill (no purchasing, transport, etc). There exist today very efficient burners specially designed for sunflower Hulls; of easy operation and low maintenance. Caloric values for Hulls are 2-3 weight Hulls equal one weight fuel-oil. Mills that have this equipment produce all the steam they need. Relative to decorticating efficiency, there is usually still a Hull surplus. In those cases we have known of mills producing electric energy for sale.

Discussion. The sunflower milling industry is obviously a well established, succesful and profitable enterprise the world over. Untold amounts have been invested in building and equip ping high quality mills and accessory organizations. These facts incline us to wonder why it is allowed that millions of tons of an inert material, damaging to quality and quantity of production, enter the process together with Kernels:apparently -in some cases- without even trying to prevent it.
We have some small information about regulations in Russia (of some years ago) establishing limits for the amount of Hulls in Kernels. Also of the minimum limits of Hulls for continous pressing. Some few important mills do decorticate with advantage, so why not all?. We, as technicians, do not dare enter a discussion on the commercial side of the bussiness. In some cases it may be advantageous to sell low quality Meals,containing in their composition all the Hulls. But, we ask, why mill the Hulls and disregard the advantages of far greater capacity, lower costs, etc.? Also the possibility of producing different quality Meals, following variations in the market? We find it an intriguing point, specially because of the relatively small investiment it implies.

Conclussions. We believe there is not much more to be said from a technical viewpoint, at this stage. But we also believe in the necessity of urgently increasing capacity and lowering costs, in a world where populations increase alarmingly,where hunger is rampant in several areas and, also, where protection ism and other meassures are suggesting the possibility of ever stronger competition.

Percentage Hulls %	Weight Dry Pulp (Unit)	Weight Dry Hulls (Unit)	Weight Cake (Unit)	Volume Cake (Unit)	Increase in milling capacity %	Weight Meal (Unit)	Fiber in Meal %	Protein in Meal %	Specific Weight Meal (Unit)
25	36	30,67	84,93	98,48	---	76,63	27,77	26,10	0,86
20	36	23,00	75,16	83,43	18	67,82	24,60	29,49	0,91
16	36	17,52	68,18	72,69	35	61,52	21,77	32,51	0,95
12	36	12,54	61,83	62,91	56	55,79	18,65	35,84	1,00
10	36	10,22	58,88	58,36	69	53,13	16,96	37,64	1,03
8	36	8,00	56,05	54,00	82	50,57	15,19	39,54	1,06
6	36	5,87	53,34	49,83	98	48,13	13,30	41,55	1,10