SLOPE DIFFUSER OPERATION
OPTIMIZING TEMPERATURES

Advantages of the "Flat Profile"
and pulp water separation

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SLOPE DIFFUSER OPERATION-OPTIMIZING TEMPERATURES

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ADVANTAGES OF THE FLAT TEMPERATURE PROFILE AND SEPARATION OF PULP PRESS WATER

The slope diffuser with external heating elements may at times be operated at excessive temperatures with the following negative results:

1) Reduced diffuser elimination
2) Increased pressed pulp moisture
3) Increased fuel cost

As we all know extraction of sugar from the cossettes (or efficient diffusion) does not begin until the cossette cells have reached their proper denaturing temperature.

A review of this subject on page 120 of McGinnis 3rd Edition shows these rates of denaturization expressed at 50-60-70-80° C. Denaturization can begin as low as 50° but the % is low and the time needed is extended. The 80° temperature range will give a much higher % of denaturization at a shorter period of time. With this being true, if the diffuser operators primary focus is on pulp losses they may be led to favor the 80° plus center temperature which will produce lower or better pulp sugar losses.

They should also be evaluating the less obvious effects of using these higher temperatures, especially when processing lower quality or degraded beets.

As previously stated these are:

1) Reduced elimination (by over extraction of non-sugars and impurities)

2) Increased pressed pulp moisture (by over heating the cell walls and reducing the rigidity of the exhausted pulp prior to pressing)

3) Increased fuel cost (extra vapors at the diffuser and extra fuel use at the drier)

Most often when the higher center temperatures are used they are followed with lower exit temperatures in an effort to improve the pulp pressability. This is called the "High-Low Profile" as seen in Example I. An alternative would be the "Flat Profile" also shown on Example I.

Regarding Diffuser Elimination - High-Low vs. Flat

With the Flat Profile the temperature is raised only to the needed denaturization point of the cossettes being processed (normally in the 70°-72° range). But the extraction time is now extended giving maximum extraction of sucrose with a minimum extraction of non-sugars.

Regarding Pressed Pulp Moisture

A direct correlation can be found between high diffusion temperatures and an increased pressed pulp moisture content. Improvements in pressed pulp moisture can be made by holding the maximun temperature of the cossettes at the lowest possible diffusion range and then adjusting the pulp out pH and reducing the pulp press speeds.

Pulp that has been softened by exposure to high diffusion temperature is not then reconstituted by the lowering of this temperature. Pulp that has been heated to 90° then cooled to 50° will have an average temperature of 70°, but will not have the same good pressing conditions of pulp that has been held to a 70° maximum.

Improvements In Fuel Cost - Example II

This Flat Profile is made possible when the pressed pulp water and the supply water temperatures are maintained in the 68°-72° range. Heat added to the pulp press water for sterilization and heat available from house hot waters going to the supply water are now used for diffusion, with a significant reduction in the vapors that were being used at the cossette end of the diffuser.

Pulp Losses - Example III

Separation of the press water will lower the pulp sugar loss by not recycling the return sugars with the fresh supply water. This allows the exausted pulp-out to then be rinsed with fresh water only in the last (drain) section of the diffuser. The higher RDS pressed pulp water is then returned down stream in the diffuser at a point where the sugar concentration in the juice is the same as that in the pulp press water.

Proposed Changes To Consider

(1) Lower the center temperature to 70°-72° and raise the supply and pressed pulp water temperatures to the 68°-72° range. This lengthens the diffuser and extends the time that the cossettes are at diffusion temperature by 50% over the high-low profile.

(2) The heat being added to the pressed pulp water (for sterilization) and the heat being saved in the supply water by not cooling it, is now being used in the diffuser to maintain the center or diffusion temperature. There will be a net reduction of energy used, as vapors are significantly reduced for the heating of the center and cossette end.

If raw juice recycle is being used at the low end for primary heating of the incoming cossettes, this will extend the flat profile even more.

(3) Separated pulp press water should be heated for help in sterilization (raising pH) but this temperature control is critical considering the impact it will now have in the diffuser. It is recommended that a biocide (BC 800) be added just after the pressing operation, for treatment and bacterial control of this low quality pulp water prior to heating.

(4) Supply water temperature can be raised by using more of the house hot waters. This will have the added benefit of improving the quality of this supply water if condenser waters are now being used. The supply water should be pH adjusted to the 5.5-6.5 range to improve pulp pressing. Bactericide can also be added here to help with sterilization at and through the pulp presses.

(5) Since the pulp press capacity will be improved with the increased feed temperature, the press speed can now be reduced for improved pressed pulp moistures. This higher temperature at the pulp end of the diffuser, less recycle of low purity press water, and higher temperatures in and around the presses should all help in reducing the bacteria load now commonly found at the press station.

CONCLUSION:

Lower center or maximum temperature in the diffuser, and an extended denaturization period should improve extraction or elimination, especially when processing lower quality or degraded beets.

Benefits to this control scheme are:

Possible energy reductions at the diffuser and pulp drying.

Improved elimination and pH control in the diffuser and pulp press water system.

More uniform countercurrent juice/cossette flow with improved foam control, less plug-ups and a higher slice rate.

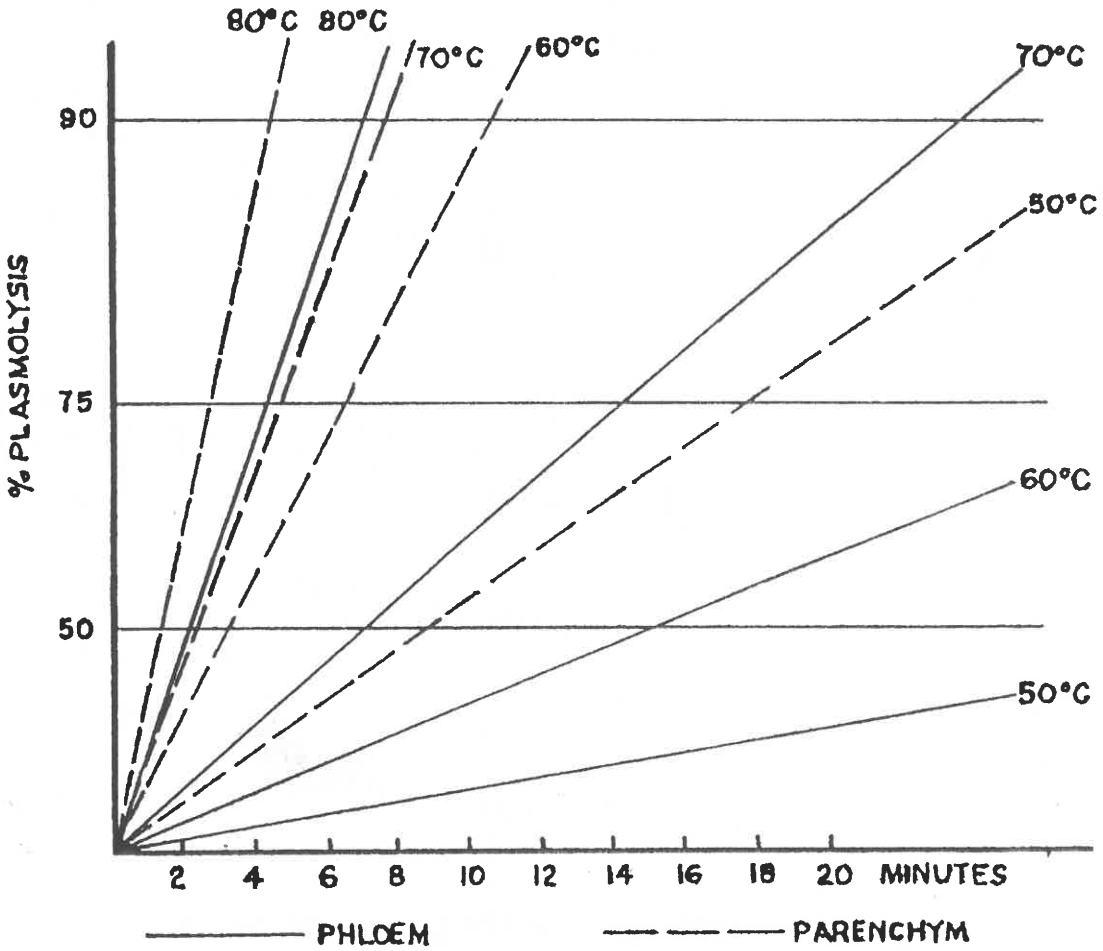
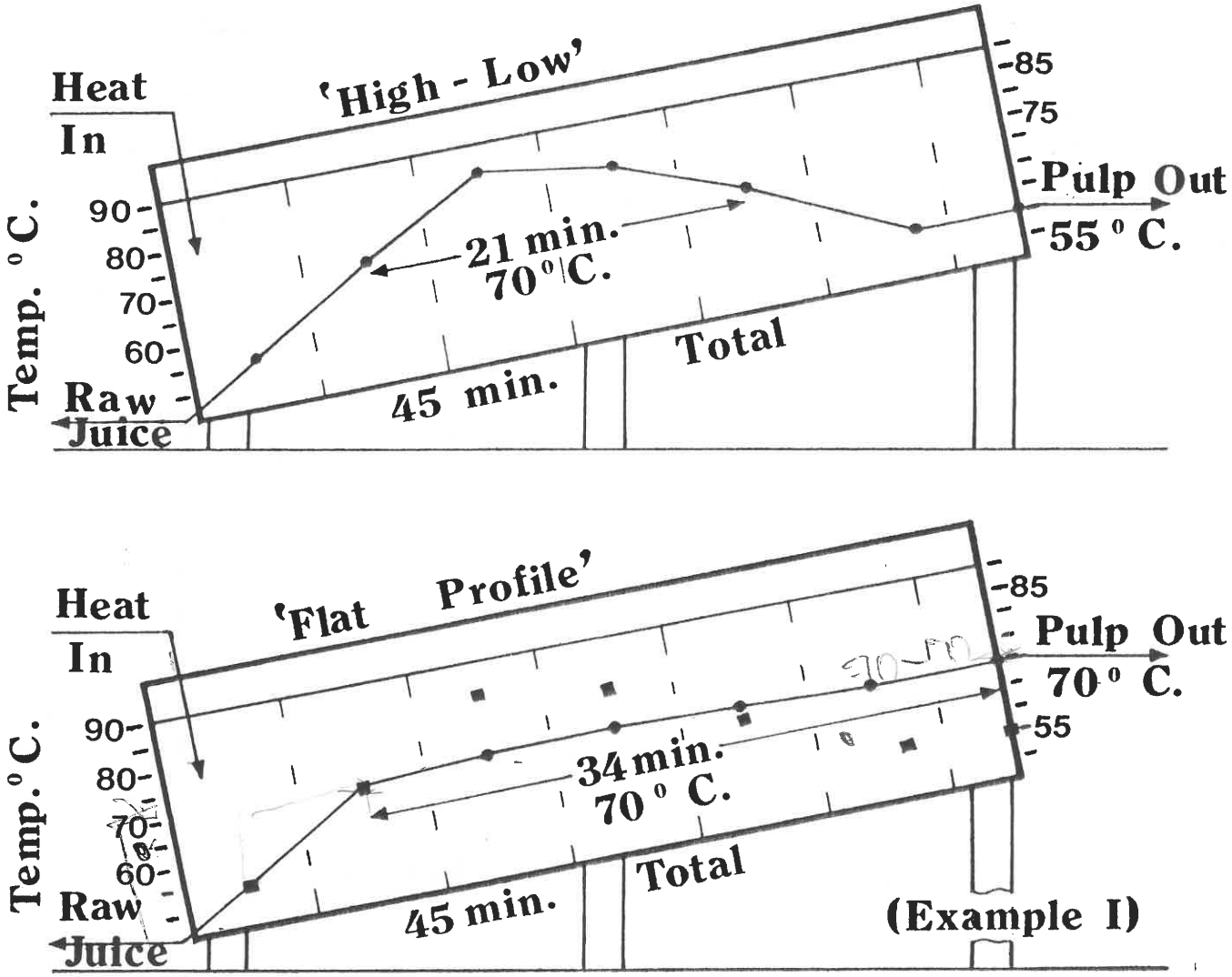
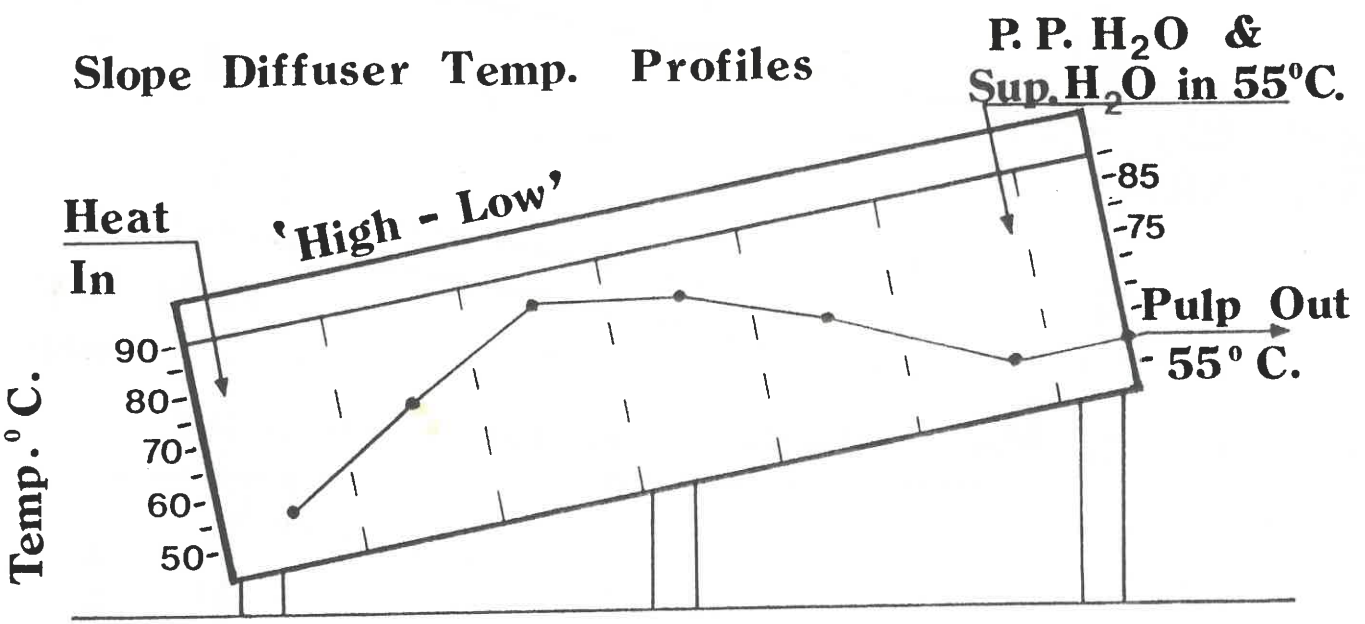


Figure 6.1 Rate of denaturization of beet cells in diffuser (45).

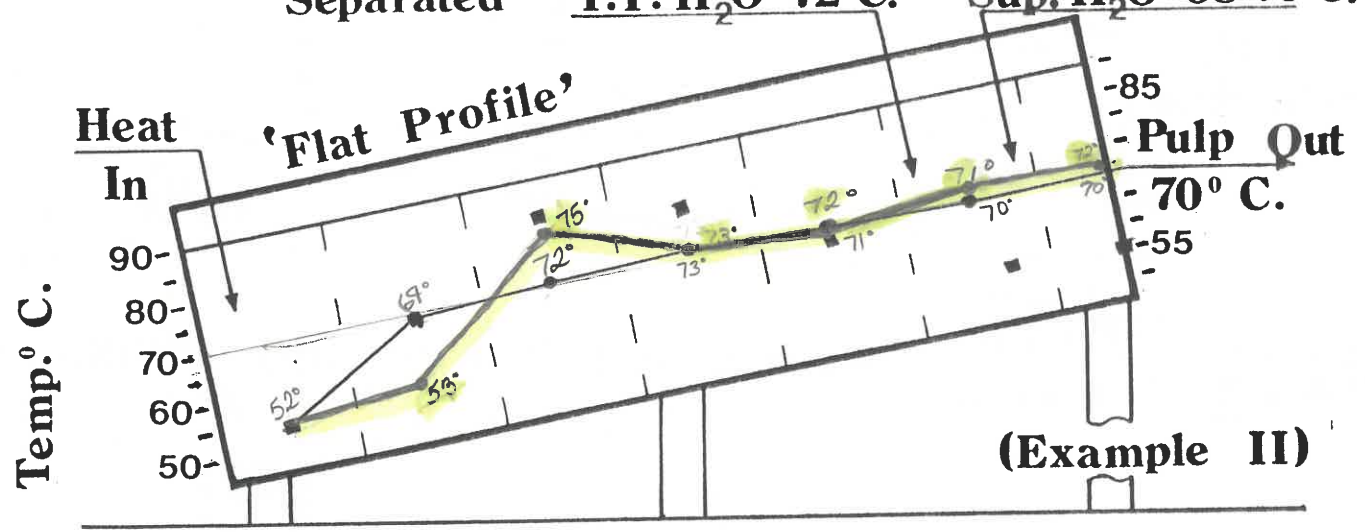
Slope Diffuser Temp. Profiles



Slope Diffuser Temp. Profiles



Separated P.P. H_2O 72°C. Sup. H_2O 68-70°C.



(Example II)

GRAVEYARD profile

Slope Diffuser Pulp Loss Profiles