

# "Hi-Heat" Diffusion washing in Kamyr digester

KAMYR A. B.

During the last years the importance of improved brown stock washing has increased tremendously. This is not due to the economic question of reduced salt cake losses, but due primarily to the increased demands by the authorities on reduced pollution from the pulp mills.

Until not very long ago the standard brown stock washing system consisted of a number of drum washers in series with intermediate mixers, a number of tanks and pumps, and much piping and valves. Such drum washer plants were manufactured by a great many companies but they all had the same negative characteristics:

- they were complicated
- they were difficult to operate
- they had a tendency to create foam
- their power consumption was high
- the space needed was big

With all these drawbacks the drum washer plants were still very limited in total efficiency. They usually consisted of 3 to 4 washers in series and to add more washers did not reduce the losses very much and it was obvious that other methods of washing were needed in order to get down to what the authorities demanded or were going to demand.

When KAMYR introduced the so called Diffusion-Extraction in connection with the "Cold Blow" from the continuous digester, a first step was taken towards a better washing system. The second step, and a very important one, was the introduction of "Hi-Heat" washing inside the digester. Most of the audience are probably familiar with this system, but a short description is given below.

Figure 1 illustrates the principle of the "Hi-Heat" diffusion washing. The cooked chips, which still retain their shape, enter the washing zone at full cooking temperature. To avoid any further cooking, which may cause an uneven pulp quality, the pulp is cooled to washing temperature by a radial displacement circulation. This circulation not

only cools the whole cross-section of the digester but it also accomplishes a certain washing effect by a radial displacement of the concentrated black liquor. The black liquor and the wash liquor are extracted as a mixture at a strainer located immediately above the displacement circulation. The wash liquor is injected in the bottom of the digester and flows upwards counter-currently to the chip flow. Slightly above the digester bottom the wash liquor is heated in a circulation to 120°C-130°C. Thus the counter-current washing is carried

out at an elevated temperature in order to increase the rate of diffusion of the chemicals and thereby increase the efficiency of the washing.

For many years this "Hi-Heat" system was followed by one or two conventional drum washers for final washing and the combination was simpler and easier to operate than conventional washing plants and gave better results. It was not completely closed, however and we knew that further improvements had to be made in order to meet the demands on pollution control.

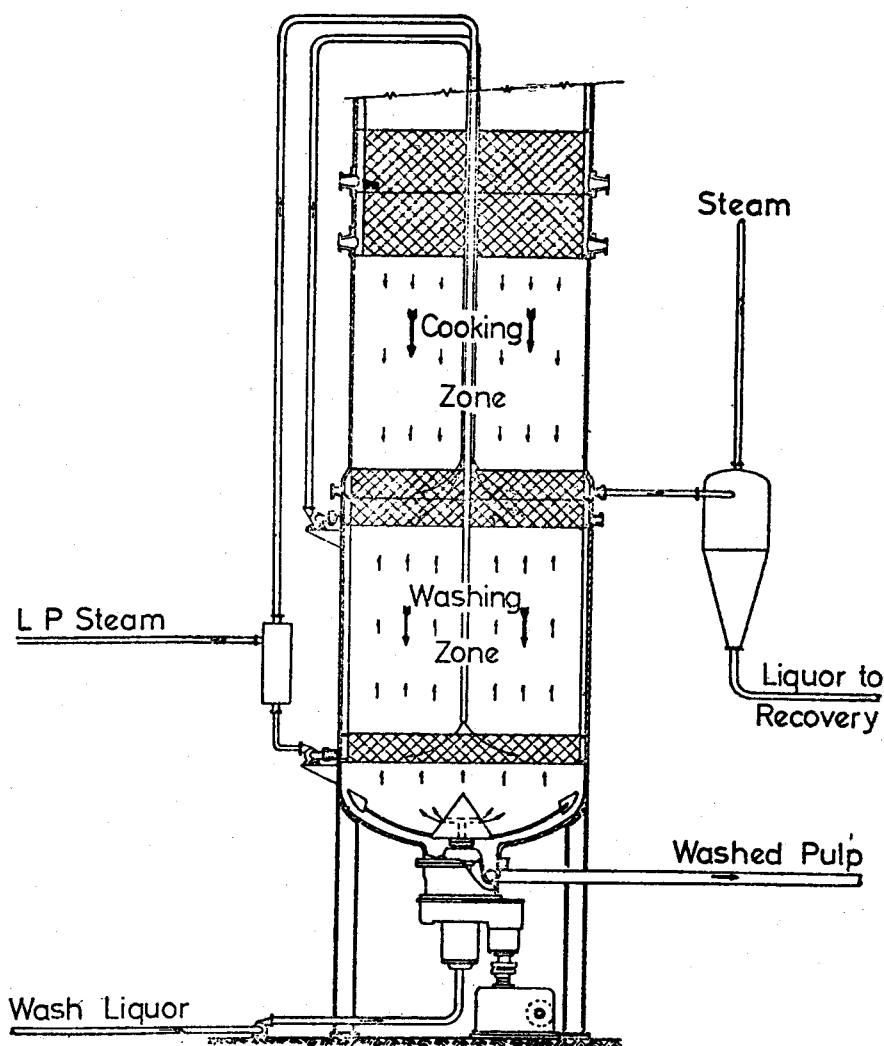


Fig. 1

Kamyr A. B., Aktiebolag, Sweden.

Then KAMYR started with the development of their continuous diffuser and the first trial installation was erected in the Swedish pulp mill, Fengersfors AB, where it was placed after their Kamyr digesters. This same mill actually brought

the very first commercial scale Kamyr digester in 1949. As with all new machinery quite some time was needed to make modifications but finally the diffuser could be said to work satisfactorily and give the results Kamyr was aiming at. A short description of the principle of the diffuser follows below. See figure 2.

Inside the shell there are concentric double-sided screen rings. The lower part of each screen ring is fastened to radial drainage arms which in turn have vertical lifting bars at the ends connected to hydraulic cylinders for up and down movement.

The pulp enters in the bottom of the conical part of the shell and moves upwards and between the screens. The wash liquid is introduced into the pulp through nozzles which are passing between the screen rings.

The nozzles are erected on a set of rotating arms which conveys the wash liquid from the wash liquid distribution box to the nozzles. The wash liquid displaces the liquor in the pulp suspension both towards the concave and the convex sides of the screen rings.

Displacement and washing takes place during approx. 7 minutes. The displaced liquor, thus collected by the screens, is flowing down to the drainage arms and out from the diffuser washer to a collecting pipe. The washed pulp is discharged with scraper plates erected on the rotating arms to a common outlet in the same manner as conventional upflow bleaching tower.

The automatically regulated hydraulic cylinders are lifting the screen unit with approximately the same speed as the pulp suspension is moving upwards.

At the end of the lift the screen unit has a rapid downward movement which is also automatically regulated by the hydraulic cylinders. This movement between pulp and screens keeps the screen holes free from fibres.

In the combination Kamyr digester and diffuser, figure 3, the pulp from the digester after it has passed the "Hi-Heat" zone as described above is blown directly into the diffuser at a consistency of approx. 10 per cent. The diffuser is generally placed on top of a storage tower, so that the washer pulp will fall straight down into this tower. The displaced liquor from the diffuser goes via a tank and a pump back into the bottom of the digester to be used as displacement liquor in the "Hi-Heat" zone.

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## BROWN STOCK DIFFUSER WASHER

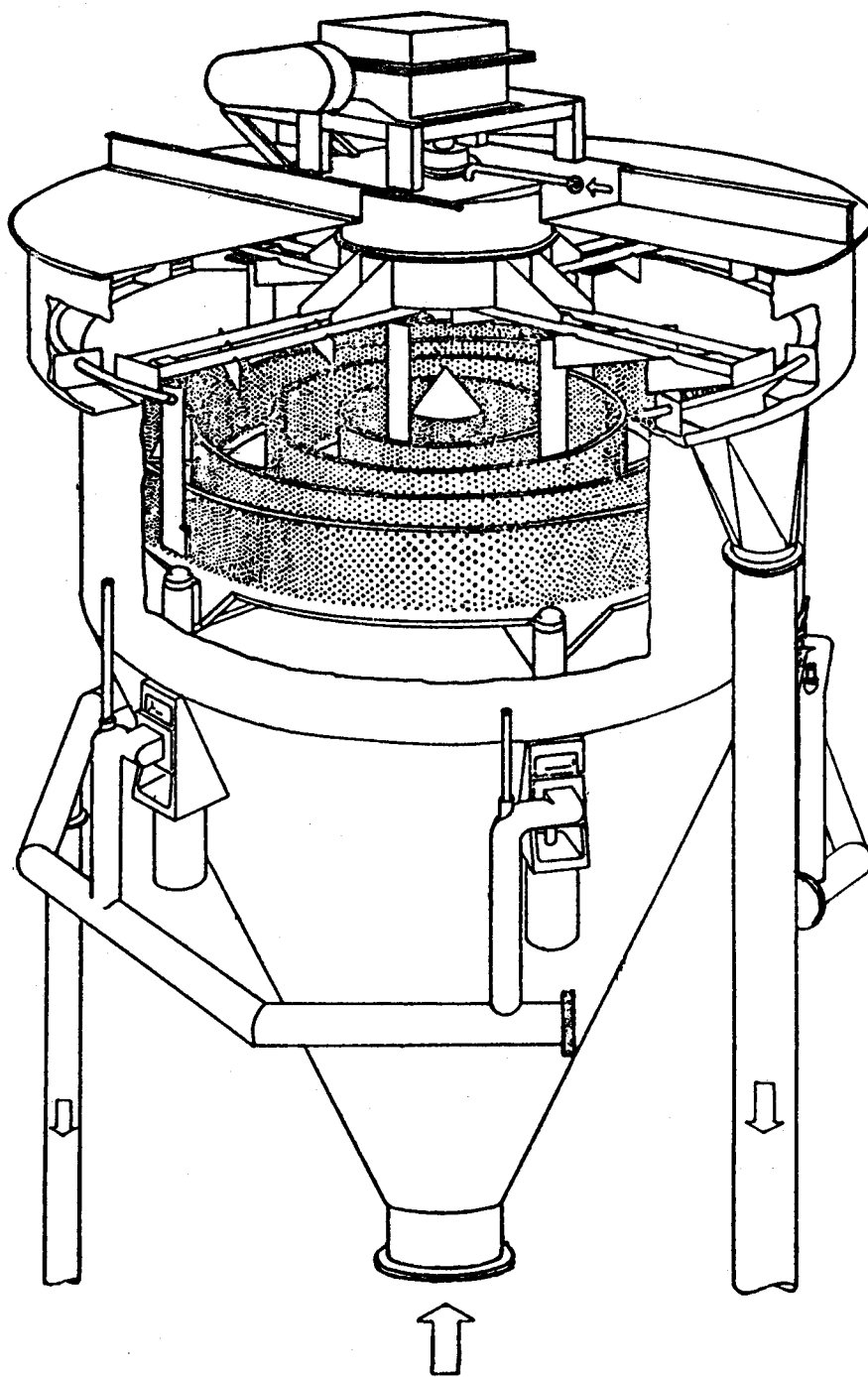


Fig. 2

As is apparent, the system is completely closed and no air is introduced at any point which ensures the best possible efficiency of the "Hi-Heat" washing and eliminates all possibility of foaming. The system is simple, easy to operate, and the power consumption is low. The ground space needed is nil as the diffuser is placed on top of the storage tower.

The first large scale Kamyr digester with "Hi-Heat" washing followed by a diffuser as described was put into operation at Crestbrook Forest Industries, Canada, at the end of 1968. As it was part of a completely new pulp mill some time was needed to trim all the departments within the mill, but during the month of April 1969 with production at the normal rate evaluation checks were made every two hours on salt cake loss yielding the following results:

|                                     |           |
|-------------------------------------|-----------|
| Monthly average salt cake loss      | 13 lb/ton |
| Samples in excess of 15 lb/ton loss | 21        |
| Samples in excess of 20 lb/ton loss | 11        |
| Samples in excess of 25 lb/ton loss | 2         |
| Samples in excess of 30 lb/ton loss | 1         |
| Total number of samples and tests   | 338       |

During the month of December 1969 data on the brown stock washing system were collected by Ekono International, Seattle, Wash., and the British Columbia Research Council, Vancouver, B.C.

#### Crestbrook Test Data December 1969

##### Design Parameters

|                |           |
|----------------|-----------|
| Rated capacity | 380 ADTPD |
| K No.          | 23        |
| Wood           | fir, pine |

##### Tests December 1969

| Tonnage ADTPD | Dilution Factor |          | Washable $\text{Na}_2\text{SO}_4$ Loss lb/ADT |
|---------------|-----------------|----------|---|
|               | Digester        | Diffuser |   |
| 405           | 2.95            | 2.95     | 10.0  |
| 405           | 1.84            | 1.84     | 17.2  |

The second Kamyr digester followed by a diffuser washer was installed at

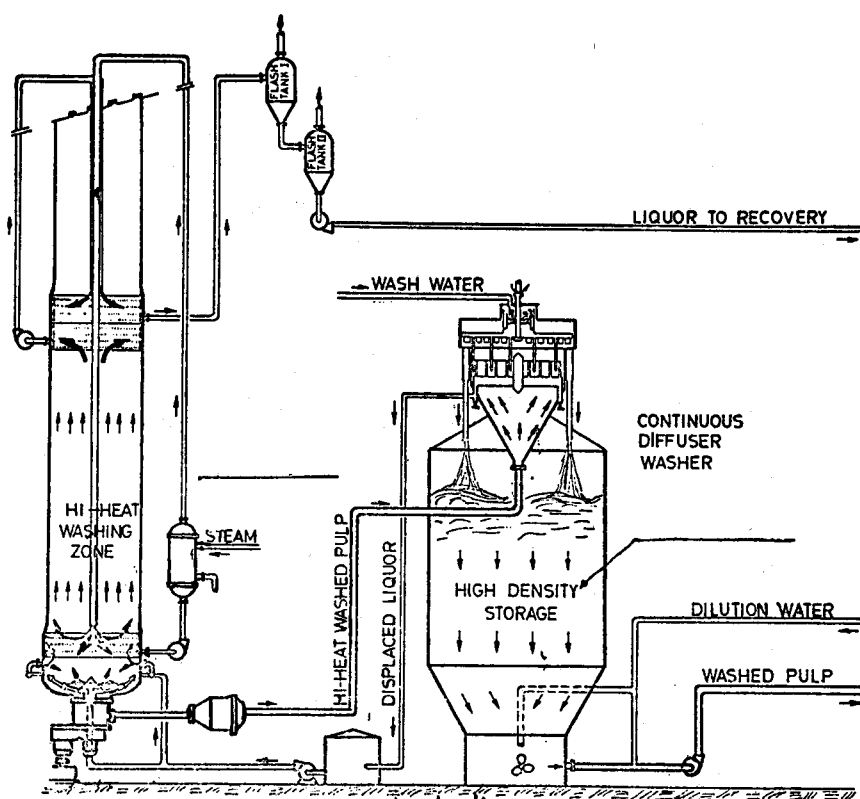


Fig. 3

the mill Frovifors Bruk, Frovi, Sweden. This mill is situated at a very small river and the authorities would not give permission for increasing the production if the pollution from the mill was not held at a very low level. After start-up of the Kamyr equipment tests were made and the average of two periods of 3 weeks each is shown below:

#### Test Data from Frovifors

##### Design Parameters

|                     |                        |
|---------------------|------------------------|
| Rated capacity      | 300 ADTPD              |
| K No. (TAPPI 40 ml) | 24                     |
| Wood                | 85% pine<br>15% spruce |

##### Tests made in February 1970

| Tonnage | Dilution Factor |          | Washable $\text{Na}_2\text{SO}_4$ Loss kg/ADT |
|---------|-----------------|----------|---|
|         | Digester        | Diffuser |   |
| 337     | 3.0             | 3.5      | 6.5   |
| 330     | 3.0             | 3.5      | 8.0   |

The operators are very happy with the system because of the factor that it needs no visual observation, which is always needed with drum washers. The operating floor for the diffusers in these mills are quite a distance away from the diffuser proper.

In addition to the advantages in regard to reduced effluent pollution, the closed system, also means that there is a complete absence of malodorous gases to the atmosphere from this part of the mill.

These two installations have been followed by a number of others in all production ranges, the largest being one for 860 ADMT. One of the mills already had a Kamyr digester but with short "Hi-Heat" followed by drum washers, and when they wanted to improve on the washing results the diffuser was added on top of the existing blow tank. This could be done with very little loss of production.

For high yield kraft pulp refining is needed before washing and this has resulted in an interesting combination, namely "Hi-Heat" — Refining — Diff-

user Washing, i.e. the refining takes place in the blow line. This arrangement is very simple and has the important advantage of refining the pulp before it has been in contact with air. Figure 4.

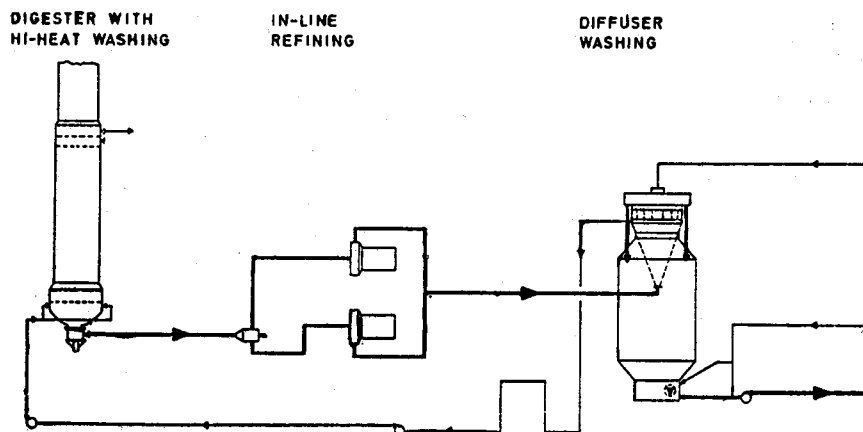


Fig. 4

The combination Kamyr digester and diffuser is not only used for kraft pulp. At Kopparfors AB, Sweden, the system is used in their Hammarby mill for the production of sulphite pulp.

The results from this installation are as follows :

#### Test Data from Hammarby

##### Design Parameters

|                |           |
|----------------|-----------|
| Rated capacity | 330 ADTPD |
| K No.          | 26        |
| Wood           | spruce    |

##### Tests made in June 1971

| Tonnage<br>ADTPD | Dilution Factor |          | Total Washing<br>Efficiency |        |
|------------------|-----------------|----------|-----------------------------|--------|
|                  | Digester        | Diffuser | Washable MgO                | Solids |
| 191*             | 1,70            | 2,04     | 97,7                        | 96,5   |
| 178*             | 3,36            | 3,15     | 99,1                        | 98,3   |

\* low capacity compared to nominal due to other parts of mill not yet finished.

The first combination of Kamyr "Hi-Heat" plus diffuser for NSSC pulp will soon start operation. Here the same

system is used as for high yield kraft pulp i.e. a refiner is installed in the blow line.

It should be noted that the system described above is operating on both softwood and hardwood chips, but also on

sawdust this system is now being applied. Because of the special characteristics of sawdust, a straight counter-current wash cannot be used and instead the Kamyr sawdust digesters are equipped with a washing zone with radial displacement (Figure 5). The water is

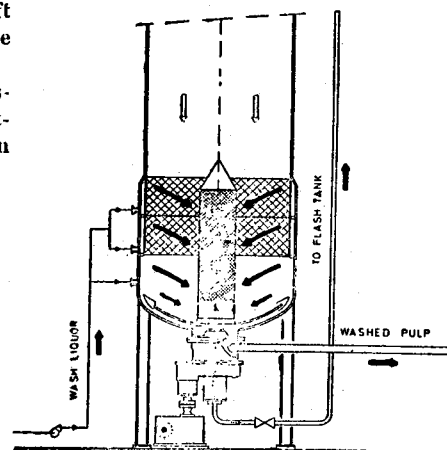


Fig. 5

added at the circumference through screens and the displaced liquor is extracted through the central pipe which is fitted to the bottom scrape (Figure 6) shows a Kamyr sawdust digester with washing followed by a diffuser.

The latest Kamyr development is the design of a two-stage diffuser — consisting of two diffusers one above the other in the same shell which will still further improve the washing results. The first unit of this type has just been put into operation.

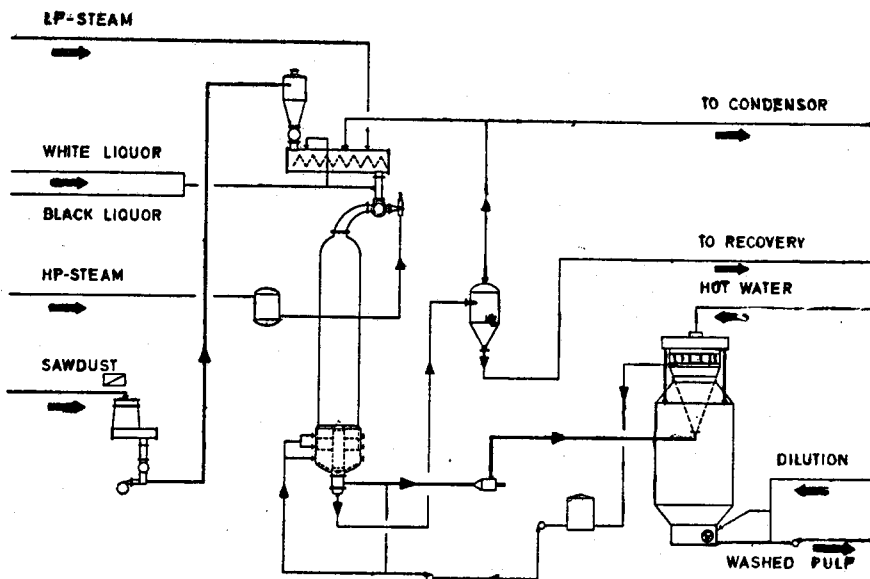


Fig. 6

Presented by Mr. N. K. Chattopadhyay at the IPPTA Annual Meeting held at New Delhi on November 8 & 9, 1971.