UTILISATION OF SUBMERGED SCRAPER CONVEYORS FOR THE REMOVAL OF BOILER BOTTOM ASH

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1. INTRODUCTION

Submerged Scraper Conveyors (SSCs) also known as Drag Link Scrapers/De-Ashers, are commonly used for the removal of Boiler Bottom Ash (BBA) from coal-fired boilers.

From a materials handling point of view the SSC therefore performs the functions of BBA collection, dewatering of BBA, and controlling the rate of discharge into downstream systems. The transport systems downstream of the SSC consist of normal belt conveyors. A typical modern boiler in Eskom generates BBA at a rate of approximately 10 TPH. The SSC also provides storage of BBA in the event of failure of the downstream plant, this is referred to as unit operational "backlog storage".

The most common problems associated with SSCs are:

- The high discharge rate of ash over the head pulley during backlog recovery.
- Poor dewatering of ash on the dewatering slope, resulting in slurry being discharged.
- Ash spillage over the side wall at the intersection between horizontal and incline during backlog recovery.
- Potential stalling of the SSC drive due to inadequate drive power during "backlog recovery" conditions.

Little information has been published on the behaviour of ash in an SSC. It was therefore decided to do testing and development work on a 1/10 scale model based on the Kendal SSC as well as on a full-scale SSC located under a 660 MW boiler at Matimba in order to evaluate performance in the process of ash handling.

Essential knowledge was gained from the investigations with regard to ash movement in the SSC, the ash flow mechanism at the submerged intersection between the horizontal section and the dewatering slope, and the contribution to absorbed power of ash moving through the water bath to the SSC discharge.

2. SCOPE

This paper is presented to assist in providing insight into material behaviour during the transportation and dewatering of ash in an SSC under various operating conditions.

Various designs to control the discharge rate, the dewatering properties and the power consumption of the SSC are evaluated. The objective of this study is to propose workable solutions to improve the overall reliability and operability of these units.

3. DISCUSSION

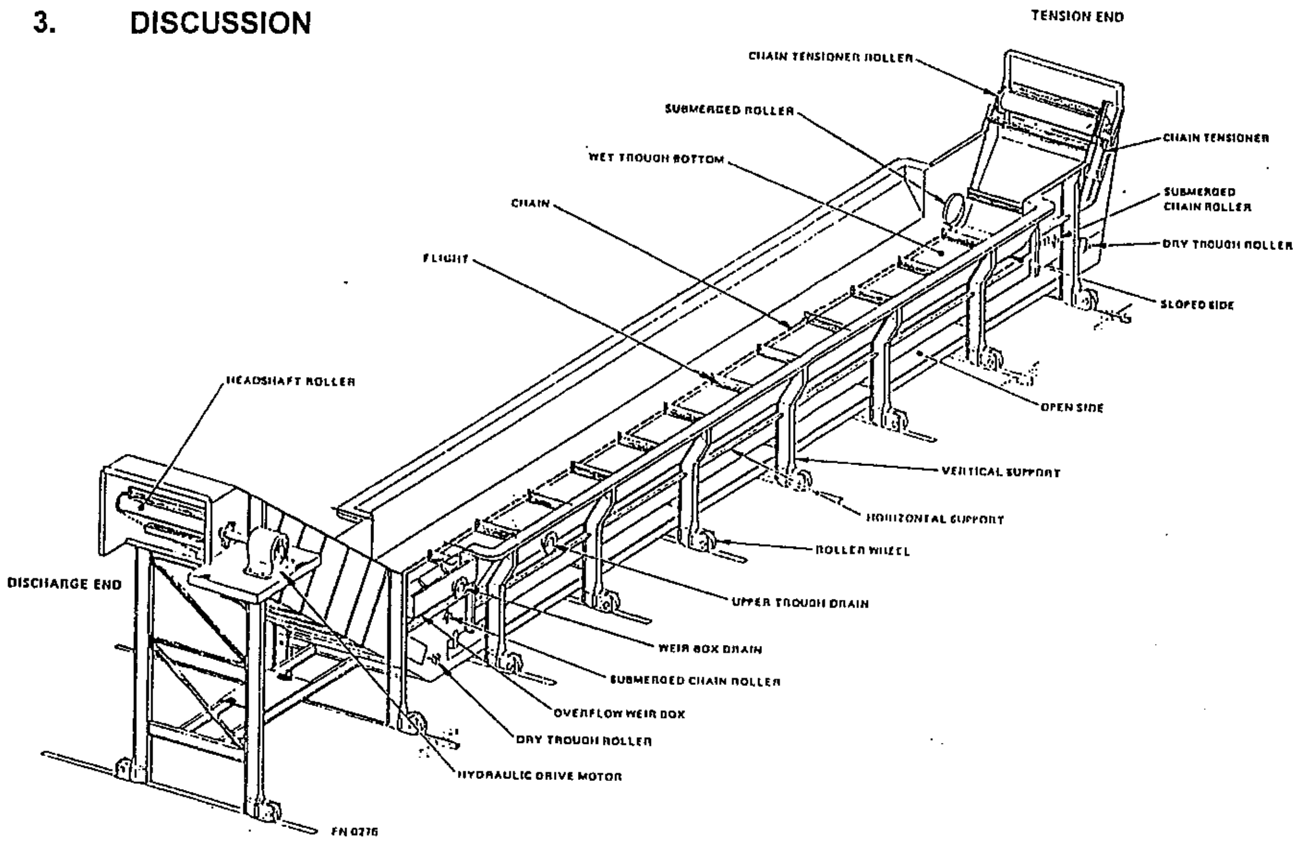


Fig 1: Schematic of an SSC arrangement

3.1 The SSC consists mainly of the following components (Fig 1):

- The horizontal trough, which consists of the wet (water bath) and dry section.
- The dewatering slope.
- The chain and scraper (flight) system.
- The head (drive) and tail (take-up) sprockets.
- Idlers to guide the chain.

3.2 Designing the System Downstream of the SSC (Normally Belt Conveyors)

In designing the system downstream of the SSC the Design Engineer is confronted with the following problems: volumetric discharge from the SSC, moisture content of the ash discharge, sizing, layout and spillage control of the system.

The operating conditions for an SSC in "normal operation" differ considerably from those for "backlog recovery" ("Backlog recovery" is the clearance of backlog storage plus the normal ash make) as far as capacity is concerned.

When operating under "normal conditions", the chain scrapers, convey a small amount of ash (Fig 2), but during backlog recovery this load increases drastically to the extent where the scrapers are completely covered by the ash load (Fig 3).

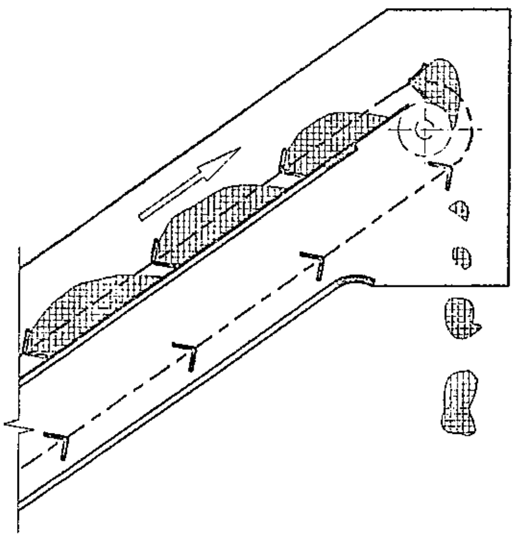


Fig.2: Ash load on dewatering slope during "Normal Operation"

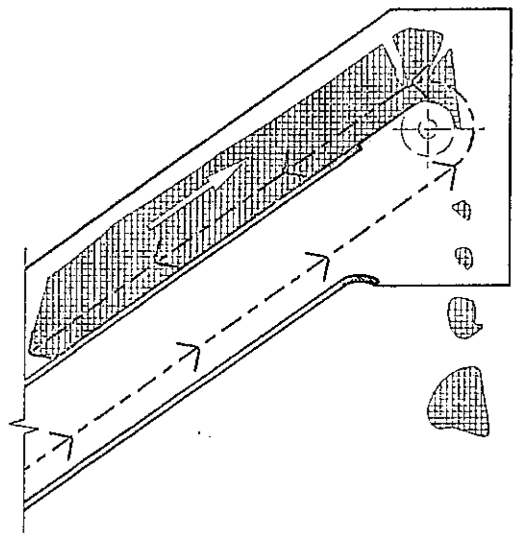


Fig.3: Ash load on dewatering slope during "Backlog Recovery"

This high-load condition during backlog recovery necessitates oversizing of the downstream system in order to accommodate the high instantaneous discharge from the SSC caused by batching as the ash breaks away from the pulley due to the bending effect.

The depth of the ash load on the dewatering slope during backlog recovery poses dewatering problems (dewatering efficiency improves with a shallow ash load). This condition caused slurry to be discharged over the head pulley, which results in spillage, blockages and backflow problems in the downstream plant.

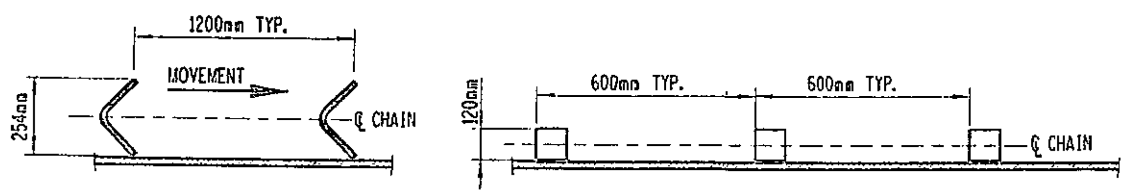
4. PROCESS DESCRIPTION

4.1 The investigation, research and engineering development in respect of material-handling behaviour during the transportation and dewatering of ash in an SSC are focused mainly on the following:

- The efficiency of various devices in restricting the maximum instantaneous ash discharge from the SSC during backlog recovery.
- Trends in absorbed power and the mass discharge rate of ash with changes to various operating variables such as chain speed and with various "restrictive" devices placed in the flow path of the ash leaving the SSC.
- Flow patterns of the ash within the submerged portion of the SSC and on the dewatering slope with changes to various operating variables and with the inclusion of various "modifications" to the SSC.

4.2 Variables and devices tested with the model of the SSC consisted of the following:

- Changes to the tension in the chain.
- Changes to the speed of operation of the scrapers.
- Changes to the chain scrapers in terms of (Fig 4):
  - pitch between scrapers
  - height/depth of the scraper cross section
  - shape of the scraper profile.



A: V-Scrapers

B: Square Scrapers

Fig 4: Types of Scrapers Tested

4.3 Insertion of various devices to restrict the loading of ash on the incline section/discharge of the SSC, namely:

- Gate near to the front dipper plate (various heights above the scrapers) (Fig 5):

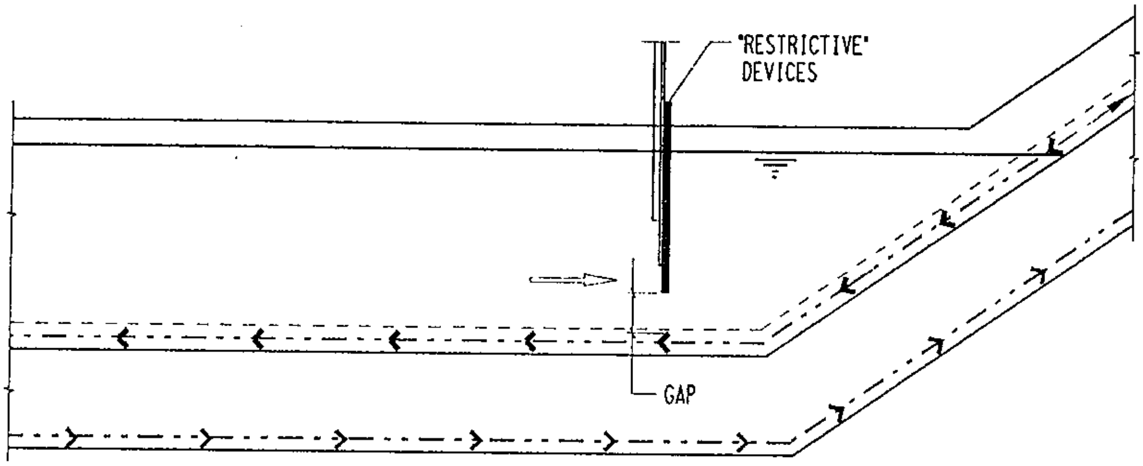


Fig 5: Gate Restriction

- Baffle plates at intermediate positions along the SSC (various heights above the scrapers) (Fig 6):

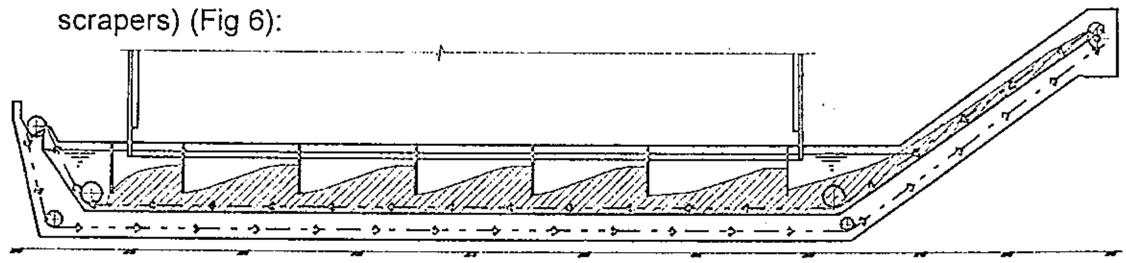


Fig 6: Baffle-Plate Restriction

- Six hoppers inside the SSC (various heights above the scrapers) (Fig 7):

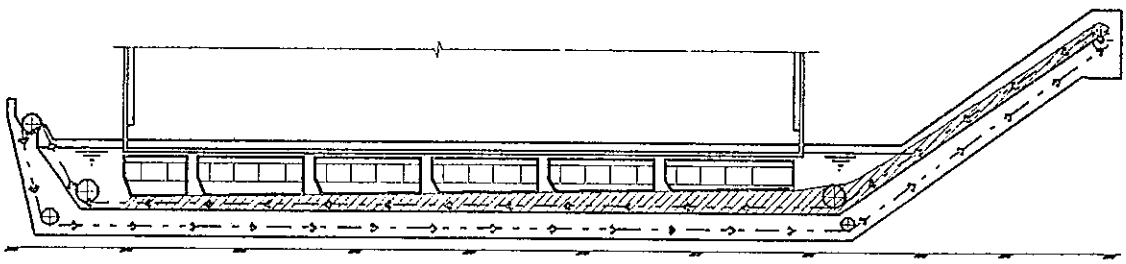


Fig 7: Hopper Restriction

- Jets of water aimed in such a way as to agitate the ash before it enters the transition/incline zone of the SSC (various orientations of the jets) (Fig 8)

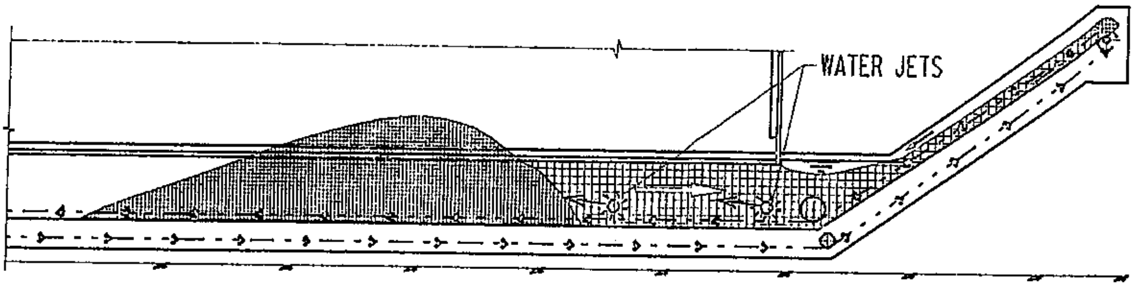


Fig 8: Water-Jet Agitation

4.4 The model was constructed mainly from Perspex to ensure that all operational aspects could be observed and recorded (Fig 9). The ash used in the model was sieved to remove particles larger than 3 mm.

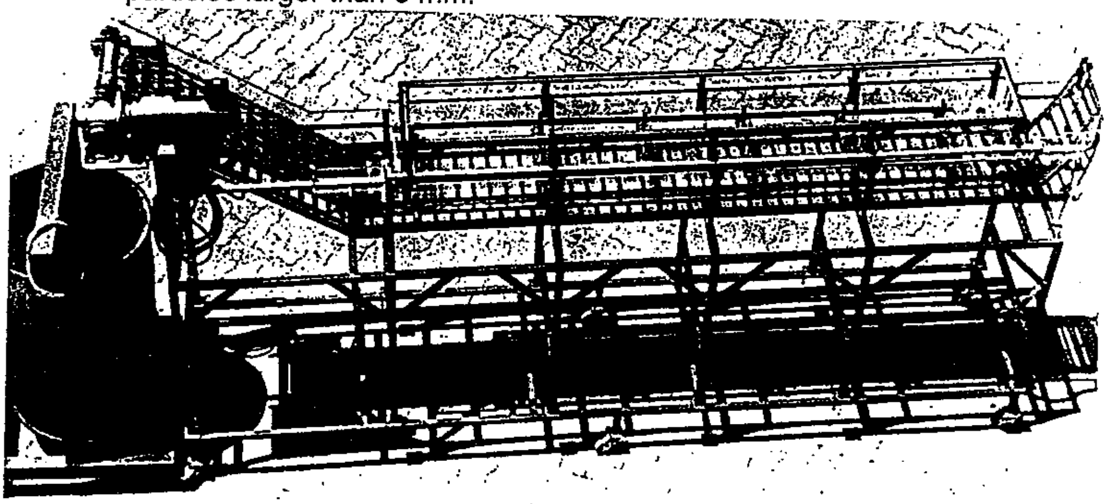


Fig 9: 1/10 Scale model of an SSC

The model is 3,5 m long and is equipped with a variable-speed drive arrangement. The collector container is supported by load cells to enable mass measurement of the discharge.

For each test the following data were logged:

- Absorbed power.
- Mass of ash discharged during the test period.
- Discharge rate.
- Peak instantaneous discharge.

Note:

The ash "discharge rate" is the accumulated mass of ash discharged for the duration of a test.

The "peak instantaneous discharge" is the instantaneous discharge mass measured on a continuous basis during each test.

In addition to the capture of the data mentioned above, photographic and video recordings were made of tests.

5. BACKLOG RECOVERY AS OBSERVED IN THE 1/10 SCALE MODEL

5.1 Ash Movement Inside the SSC Water Bath during Backlog Recovery (Fig 10)

Ash in the SSC moves forward "en masse" with the chain, until it is obstructed by the boiler front seal (dipper) plate and/or by the change in direction at the start of the dewatering slope. At these points a pile of ash is formed and the ash is carried forward from the rear of the pile (Fig10). The chain movement transfers ash from the pile into the transition zone between the horizontal section and the dewatering slope of the SSC. The height of the ash stream "entering" this zone is limited by the opening under the dipper plate. The height of the ash pile in front of the dipper plate affects the density of ash entering the transition zone.

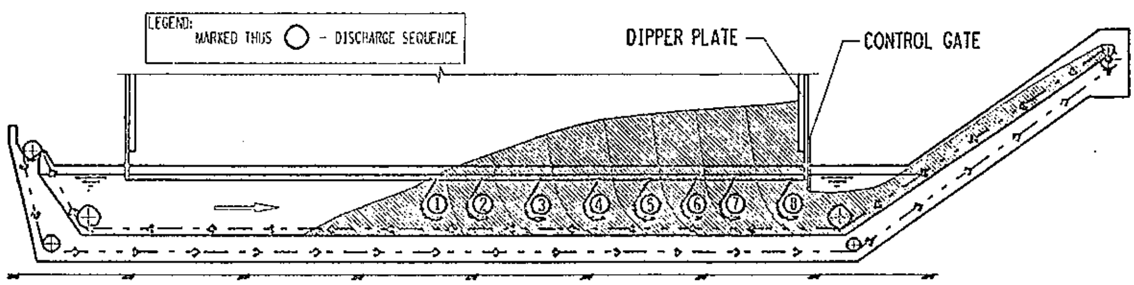


Fig 10: Ash Movement inside the SSC water bath during backlog recovery

5.2 Ash Flow Behaviour at the Submerged Transition Point between the Horizontal and Inclined Travel Direction.

The ash moves with the chain to the transition point where the travel direction changes from horizontal to inclined (Fig 11). At this point the ash load is "fluidised" and the bulk density drops. The ash tumbles/flows backwards, down the submerged portion of the dewatering slope, to its natural angle of repose in the water as indicated in Fig 11.

When the ash is moved out of the water (up the dewatering slope), it has a different angle of repose and it is once again transported "en masse". As there is a high water content in the ash being transported up the dewatering slope, it tends to flow backwards to the "wet ash" angle of repose, as shown in Fig 11, at the point immediately after exiting the water bath.

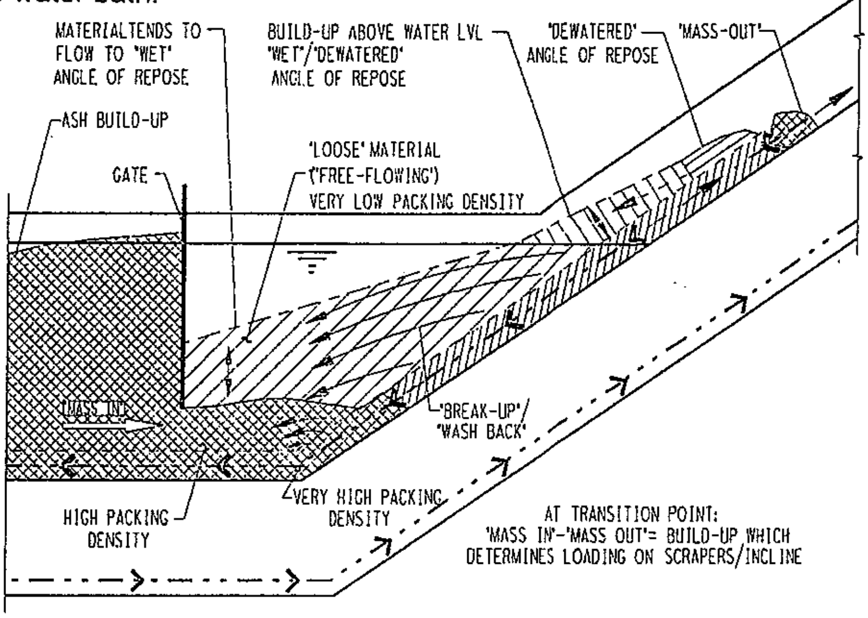


Fig 11: Ash movement inside the SSC water bath during backlog recovery

5.3 Spillage of Ash over the Side Wall During Backlog Recovery

Spillage of ash over the sides of the SSC where the horizontal wall meets the inclined wall results from the "material balance" at the transition point, as discussed above, due to a combination of the following (Fig 12):

- The rate of transport of ash into the transition zone (horizontal to incline).
- The amount of ash flowing back down the incline.
- The rate of transport of ash up the incline and discharge from the SSC.

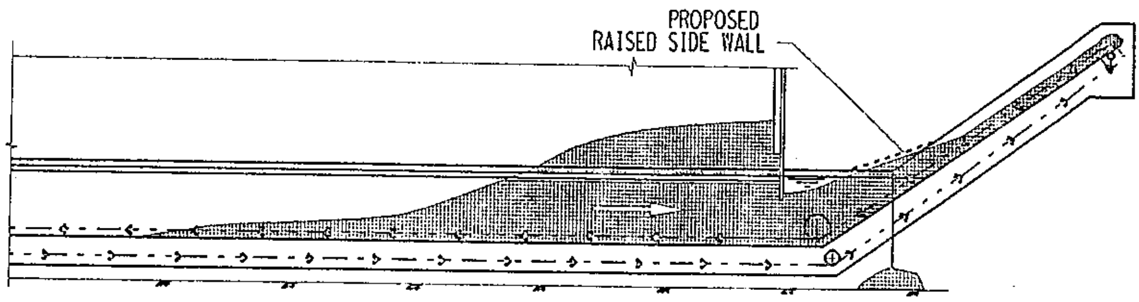


Fig 12: Spillage of ash over side walls during backlog recovery "as is"

Ash builds up at the submerged area of the incline, where "fluidised" ash flows backwards down the slope as explained under item 5.2. Without adequate space for "ash storage" at this submerged incline section, ash slurry flowing back down the dewatering channels along the sides of the dewatering slope has no place to flow into. Consequently ash slurry builds up and blocks the dewatering channels, eventually overflowing the sides of the SSC (Fig 12). With the present SSC designs in Eskom the only controllable variable which can be used to "balance" the ash transfer and build-up in this zone is chain speed. Generally the amount of spillage over the side wall is less when chain speed is reduced, but on these units the manual speed adjustment alone is not capable of balancing the ash build-up to the extent where spillage does not occur.

Raising the sides of the SSC (Fig 12) effectively creates additional space for ash slurry flow-back, which can reduce or eliminate the ash spillage problem, depending on the amount of ash build-up which occurs in this area.

5.4 Ash Transfer up the Dewatering Slope during Backlog Recovery

The dewatering trough created by the side walls of the dewatering slope is generally filled volumetrically to a high level during backlog recovery (Fig 13). Along a considerable length of the incline the ash load stream is deeper than the scraper profile. Backlog recovery results in blockage of the dewatering channels back into the water bath, reduces the dewatering efficiency of the system, and contributes to the discharge of too wet ash at the head pulley.

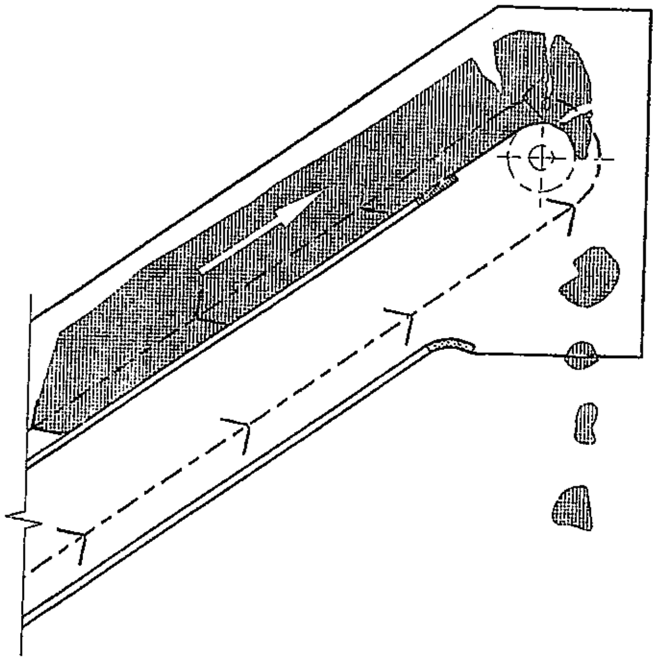


Fig 13: Ash discharge rate during backlog recovery

The depth of the load stream during backlog recovery results in a high ash discharge rate over the head pulley of the SSC, causing volumetric batching as the ash breaks away from the main load stream in "lumps" (Fig 13).

The shear plane which develops through the load stream at the head pulley is related to the ash flow characteristics (cohesion between particles) and the bending effect over the head pulley. Under "normal" operating conditions (not backlog recovery) the amount of ash generated in the boiler and discharged by the SSC is significantly less than the ash discharged during backlog recovery and this results in a low ash discharge rate.

At the design stage of sizing the plant downstream of the SSC it is difficult to predict the high discharge rate of backlog recovery, often resulting in the underdesign of the downstream system, which in turn results in blockages and spillages.

5.5 Methods of Controlling Ash Flow and Discharge from the SSC

The cross section of the ash load conveyed up the dewatering slope, and thus the ash discharge rate, is affected by the behaviour of the ash flow at the transition point between the horizontal and inclined conveying sections of the SSC trough, as discussed under item 5.2, and the material build-up at this transition zone (see item 5.3), as well as the scraper shape, pitch and speed.

The depth of the ash load as well as the ash particle size distribution affects the dewatering efficiency while the ash is moving up the dewatering slope. (Particularly with very fine BBA a deep ash load dewaters less than a shallow load.) Because of the "en masse" movement of the ash, the depth of the ash load on the dewatering slope of the SSC is affected mainly by the height of the front dipper plate opening where ash is transferred into the transition zone. The scraper height will only be effective in controlling the ash flow when operating under "normal" conditions or when used in conjunction with a restrictive device at the front of the dipper plate.

The effective control of the ash load stream entering the transition zone at the front dipper plate (orifice effect), combined with the selection of correct scraper height, pitch and chain speed, provides effective dewatering and control of the ash discharge from the SSC. Fig 14 shows the difference in ash load depth discharged with two alternative scraper heights and profiles in backlog recovery conditions. A reduction in the pitch between scrapers combined with a reduction in the height of the scrapers will optimise normal operation to provide a more consistent discharge, as indicated in Fig 15.

A: Low-Profile Scraper

B: High-Profile Scraper

Fig 14: SSC Loading during backlog recovery

A: Low-Profile Scraper

B: High-Profile Scraper

Fig 15: SSC loading under normal operation

5.6 "Restrictive Devices" for the Control of the Ash Conveyed into the Transition Zone

The function of "Restrictive devices" for the purpose of limiting the amount of ash conveyed into the horizontal-incline transition zone is to hold back the "en masse" flow of ash as described under item 5.1. This creates an orifice effect. The intention is to control the ash load on the dewatering incline as well as the mass "balance" at the transition zone to prevent spillage over the side wall interface, as discussed under item 5.3. The effect on the drive effort required with these devices is compared with that on the drive effort required for existing "uncontrolled" situations.

The following "restrictive" devices were tested individually and their effectiveness was evaluated:

- Control gate at the front dipper plate (Fig 5)
- Baffle plates located inside the SSC water bath (Fig 6).
- Profile hoppers located inside the SSC water bath (Fig 7). In addition to restricting the "en masse" movement of ash, these hoppers reduce the area of ash in contact with the scrapers at the hopper outlet by means of sloping side walls.

These restrictive devices are only effective in controlling the ash load on the dewatering slope and spillage at the wall interface between the horizontal wall and the incline if the gap between the device and the top of the scraper is "small" enough, ie if there is a **high** degree of restriction.

These devices, if correctly set up and combined with the correct chain speed, can control the ash load on the dewatering slope of the SSC.

Direct extrapolation from the test data on the model indicates that the maximum opening size for effective control in a full-scale SSC is the equivalent of a 200 mm gap between the top of the scraper and the underside of the device (Fig 16). Restrictive devices could pose practical problems in the handling of large ash clinkers in the BBA. Restrictive devices also reduce access to the boiler and other SSC components for maintenance, etc.

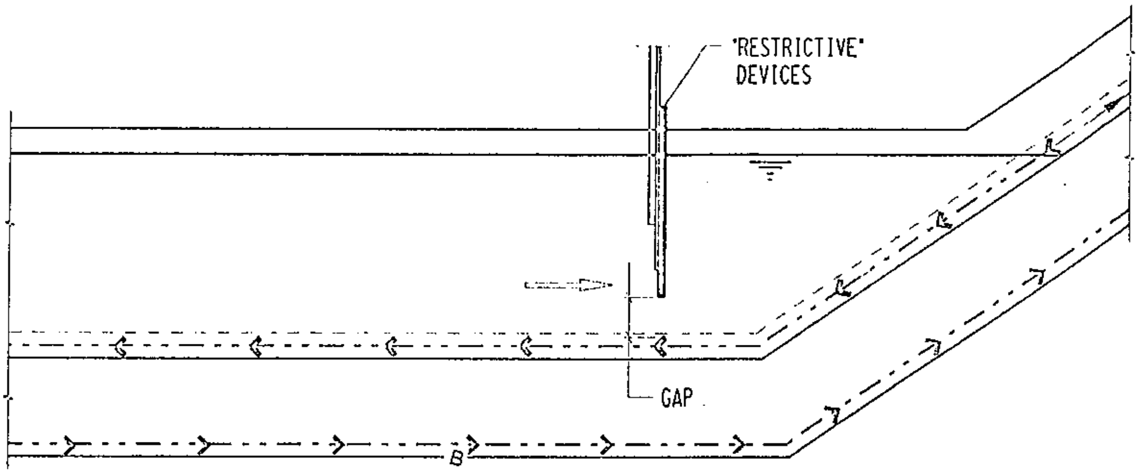
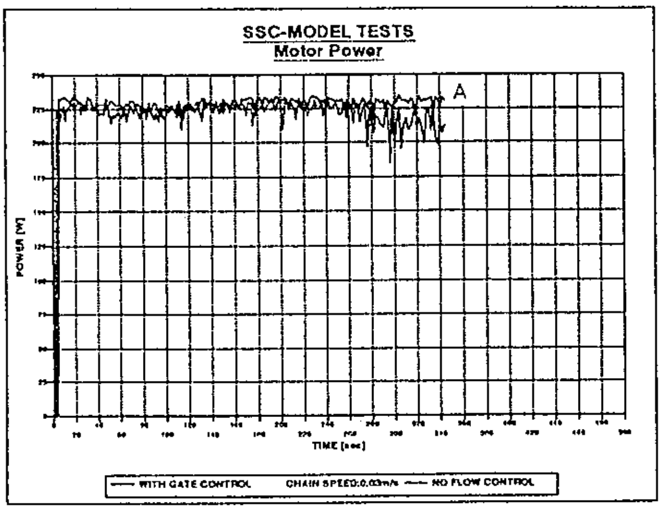


Fig 16: Opening (gap) between restrictive devices and top of scraper

5.7 Power Absorption Relative to Ash Movement with the Chain Scraper, from Collection to Discharge

In terms of the overall contribution to absorbed power, it was noted that the setting of the chain tension on the SSC had a major impact on the absorbed power.

An interesting observation made from data obtained from tests performed with restrictive devices was that although the effect on the en masse movement was considerable, the driving power requirements were similar to those in "no control" applications. (Fig 17 for power comparison between tests with no restrictive devices and tests with restrictive devices.)



A: Gate Control
B: No Flow Control

Fig 17: SSC absorbed power

One would generally assume that most of the power would be absorbed at the material shear plane which develops on the underside of the restrictive device due to the movement of the chain scrapers and the ash concentration which forms at restrictive devices, but most of the power is actually absorbed only when the ash changes direction from the horizontal to the incline section of the SSC.

The mechanisms affecting absorbed power were observed during a number of tests. An ash consignment was loaded into the SSC water bath. The SSC was then started and continuous power absorption measurements were taken for the ash consignment on its travel path through the water bath into the transition zone between the horizontal section and the incline, and up the dewatering slope to the discharge (Fig 18). These tests were repeated to confirm consistency, without any restrictive devices as well as with restrictive devices in place.

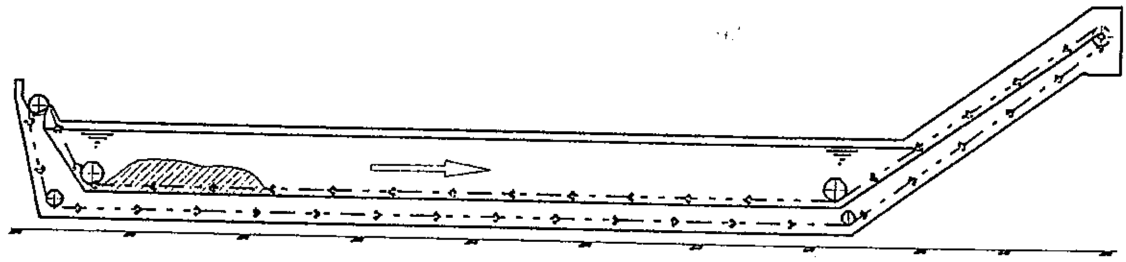


Fig 18: Ash consignment for power tests (model)

Fig 19 shows the power graph profile for an ash consignment conveyed without any restriction. The power remains constant during movement along the bottom of the water bath. The power increases at the intersection point between the horizontal and incline sections and remains constant as the ash moves up the dewatering slope, whereafter the power level drops to 'empty running' as all the ash is discharged.

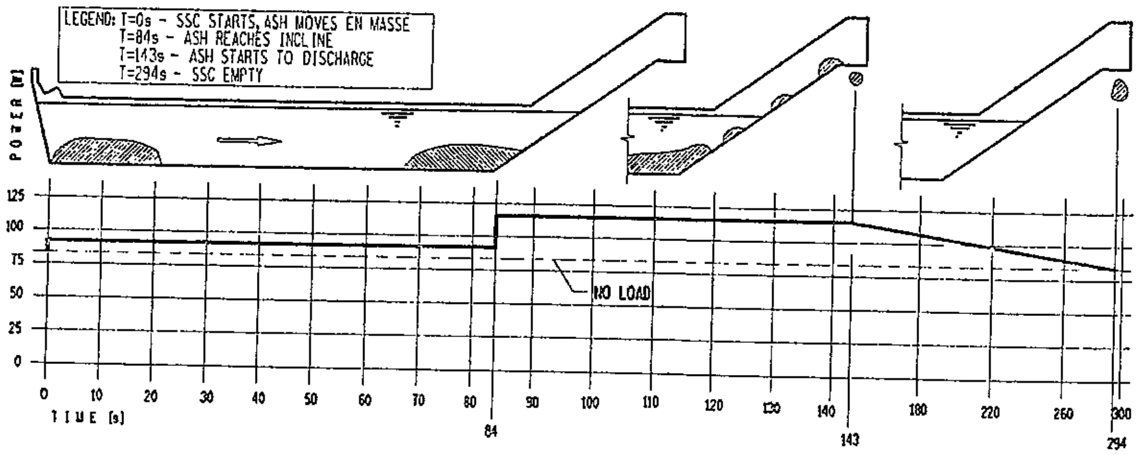


Fig.19: Power make-up "non restrictive"

The only unexpected power trend is the sudden increase in absorbed power at the transition point where the direction of the material changes (Fig 20).

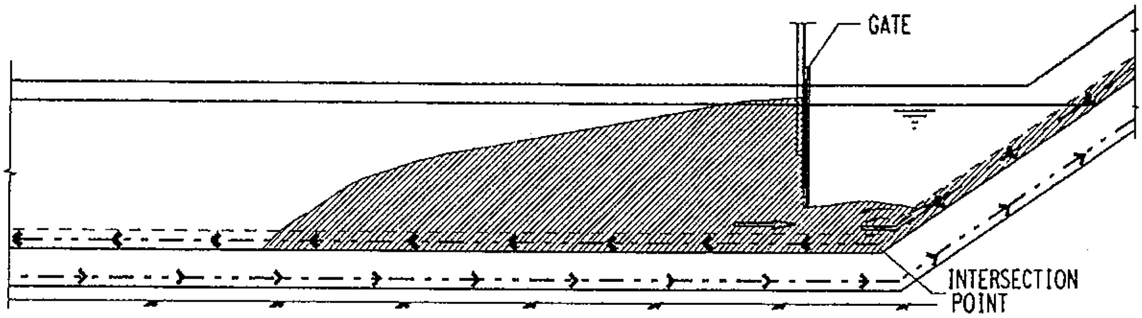


Fig 20: Ash direction change at the intersection point

Fig 21 shows the absorbed power graph profile for a test similar to the one shown above, but including a gate at the front end of the dipper plate to restrict the "en-masse" movement of ash into the transition zone.

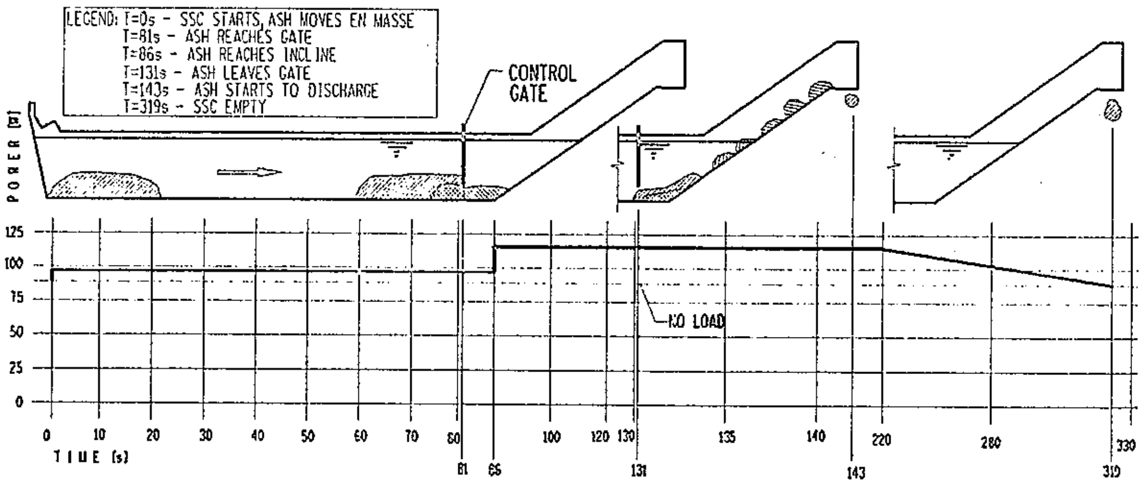


Fig 21: Power absorption with "gate restriction"

From the power graph it is evident that power remains relatively constant during the horizontal movement of the ash from the start to the intersection between horizontal and incline travel. Ash heaping at the control gate, with the associated shear of the ash stream which **enters** the transition zone, has very little effect on power (Fig 22).

An increase in power only occurs when the ash load is forced to change direction at the intersection point. Thereafter the power level remains constant once more while ash is conveyed up the dewatering slope.

It is also interesting to note that the power does not change significantly when the ash load is cleared from the control gate at the horizontal submerged travel region, but only when the transition zone (horizontal to incline) is **cleared** of ash.

This power trend indicates that most of the power is absorbed at the transition point, where the direction changes in the submerged section from horizontal to incline.

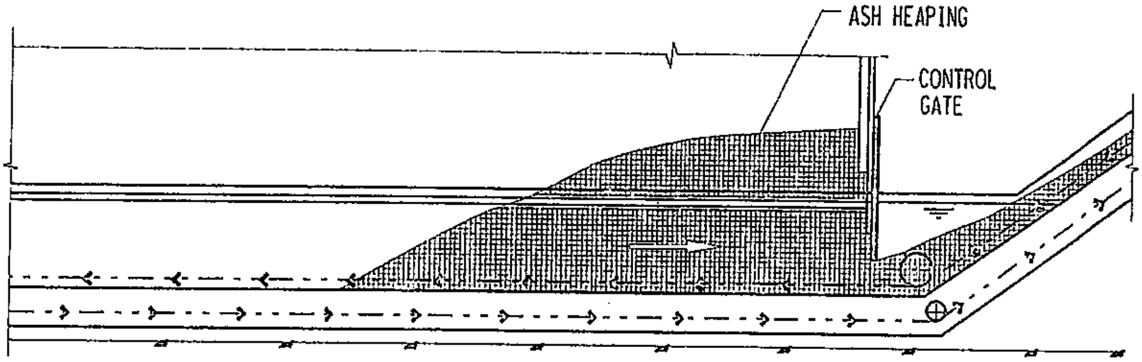


Fig 22: Ash heaping at control gate

A third test was performed. In this test hoppers were installed towards the rear end of the submerged water bath of the SSC (Fig 23). The power remained constant for the horizontal travel path of the ash until the transition zone was reached. At the transition zone, as in the previous test, a steep increase in power was noted when the ash changed direction from horizontal to incline travel. The power remained at a constant level while the ash was moving up the dewatering slope. The power decreased only after the transition zone had been cleared of ash.

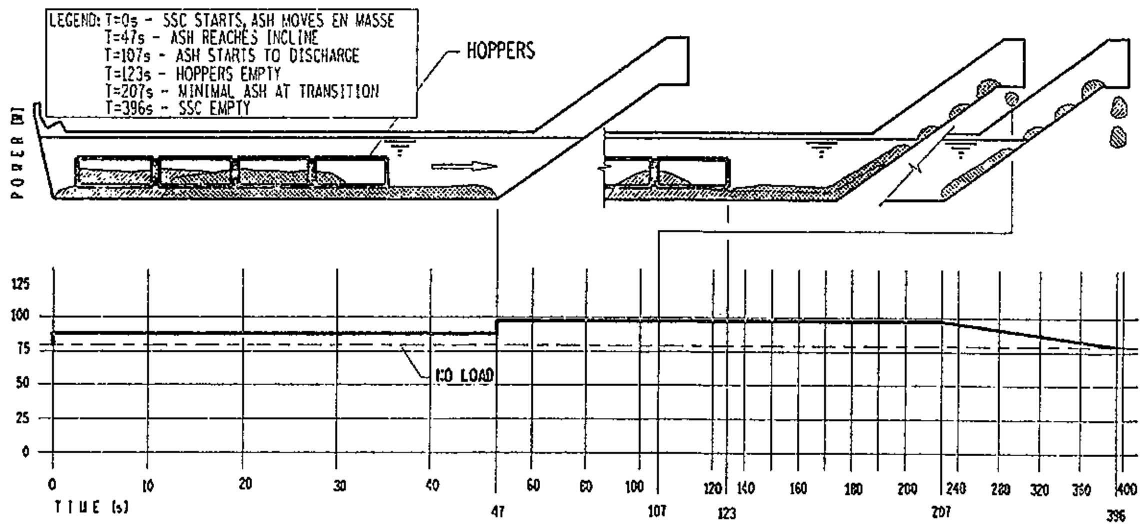


Fig 23: Power absorption with "Hopper Restriction"

From these power absorption tests it is evident that most power is absorbed at the submerged transition point where the ash load changes direction from horizontal to incline.

5.8 Utilisation of Jets of Water, without any Restrictive Devices, to Control Ash Load

Jets of water are used to agitate the ash **before** it enters the submerged transition/incline zone of the SSC (Fig 24). The objective is to control material build-up in this zone (as explained under item 5.2) and to control load up the dewatering slope.

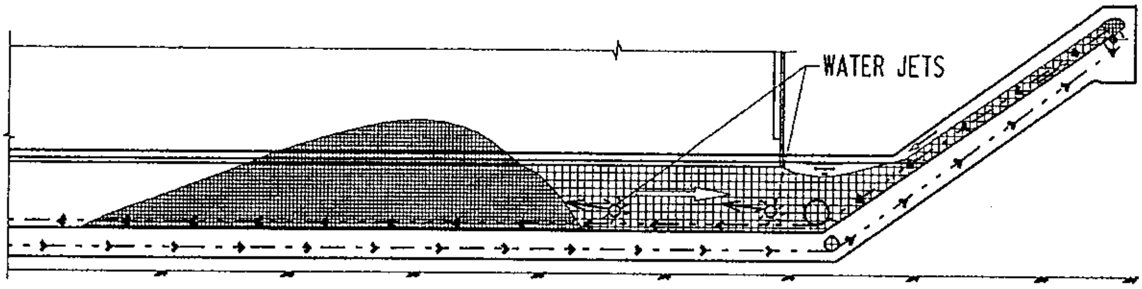


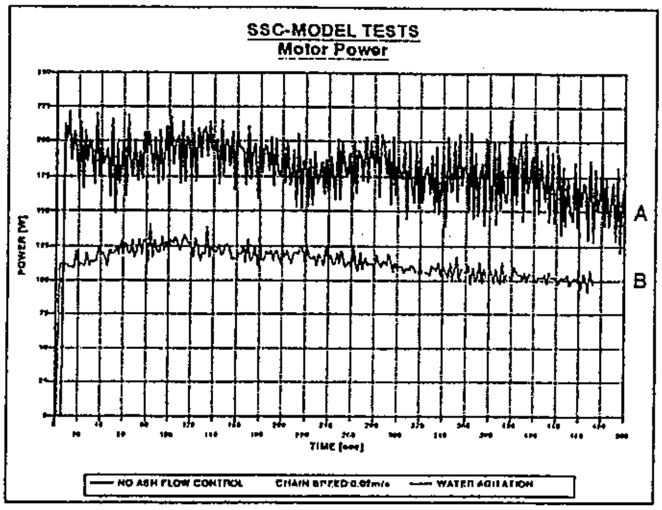
Fig 24: Backlog recovery with water agitation.

The aim is to **fluidise** and **control** the amount and density of ash **before** it reaches the transition zone in order to improve the transfer efficiency of ash in this zone and to evaluate its effect on ash load distribution up the dewatering slope and at discharge.

From the tests performed on the model with water jets it is evident that the best performance is obtained with the water jet nozzles pointing against the direction of travel of the chain and slightly above the top of the scrapers, with the jets of water crossing towards the centre line of the SSC.

Fig 25 compares the SSC absorbed power in the case of water-jet agitation of the ash with the SSC absorbed power without any material control. It is evident that for a similar chain speed the power requirement with water agitation of the ash is far less than that with no material control.

The agitation caused by the jet fluidisation of the ash during backlog recovery prevents ash build-up at the front dipper plate (Fig.24). This material flow "control" affects the ash "balance" at the transition zone, the ash level remains low and no spillage occurs over the side wall (see item 5.3).

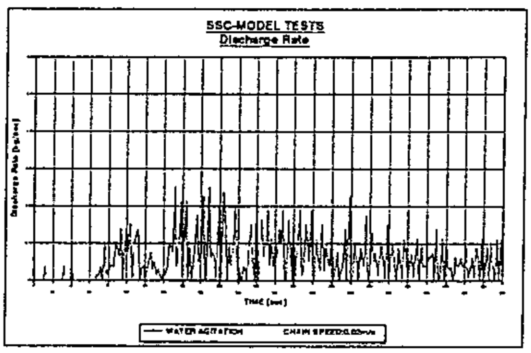


A: As is
B: Water Agitation

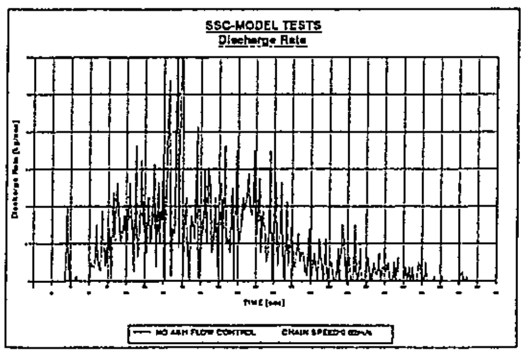
Fig 25: SSC absorbed power

The material load stream conveyed up the dewatering slope is also controlled much better (it is lower) than in a situation where there is no material control during backlog recovery.

Limiting the ash loading on the scrapers enables the dewatering channels on the incline to cope with the run-back of slurry from the dewatering process. The tests indicated that these channels then remain effective for dewatering and do not become blocked. This results in improved dewatering efficiency. The ash discharged is therefore "drier" and easier to handle in the downstream plant. The reduction in load depth due to water agitation reduces the discharge rate, as opposed to cases where there is no water agitation (Fig 26 A and B).



A: Ash discharge with water agitation



B: Ash discharge without ash flow control

Fig 26: Ash discharge rate

Fig 27 shows SSC power absorption for ash movement through the cycle of backlog recovery with water agitation of the ash (see item 5.7).

An ash consignment was loaded into the SSC water bath. The SSC was then started and the absorbed power was measured for the travel path of the ash, from initiation to discharge.

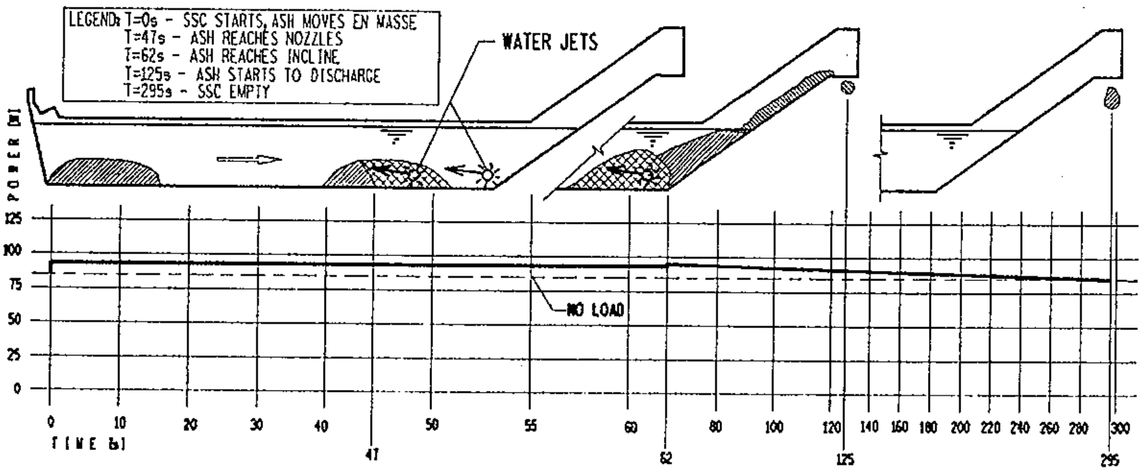


Fig 27: Power absorption with water agitation

From this power graph it is evident that only a slight increase in power is noted when the agitated ash reaches the transition point from the horizontal section to the incline. Previous tests, without water agitation, showed a significant increase in the absorbed power when the ash reached this intersection point. In item 5.7 a step in power absorption was measured at this intersection point for all the tests without water agitation.

6. BACKLOG RECOVERY AS EVALUATED IN A FULL-SCALE SSC

Backlog recovery tests were performed on an SSC situated under a 660 MW boiler at Eskom's Matimba Power Station to verify and evaluate the effect of water agitation on ash load control as determined by research with the 1/10 scale model of a Kendal SSC, as discussed under item 5 (Fig 28 for the general arrangement of the Matimba SSC.)

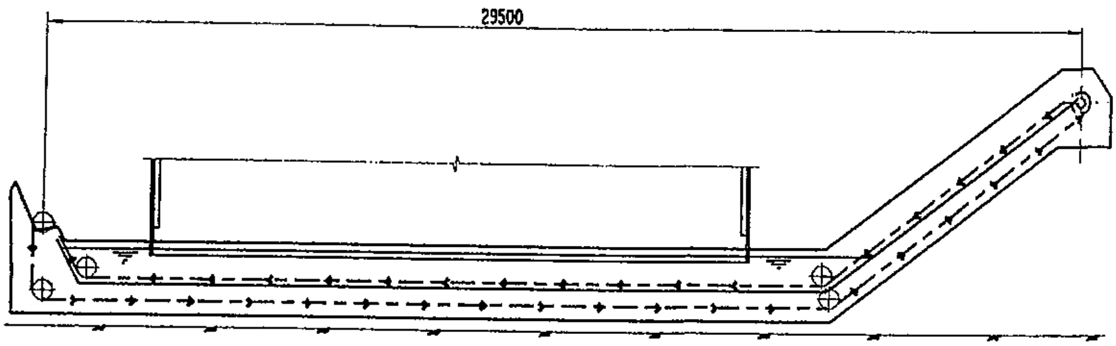


Fig 28: G A of Matimba SSC.

6.1 Backlog Recovery without Water Agitation

The ash movement in the SSC is similar to the trend observed in the model (refer to item 5.1), ie ash moves forward en masse until obstructed by the boiler front dipper plate or until a change in direction is imposed by the start of the submerged dewatering slope.

The ash flows backwards down the submerged portion of the dewatering slope and build-up occurs (Fig 29). Excessive spillage occurs over the side wall where the horizontal section meets the inclined wall, similar to that seen in the model (item 5.3). The higher the chain speed, the worse the spillage. In general the overall behaviour of the ash during backlog recovery in this full-scale SSC corresponds with the trends observed in the scale model.

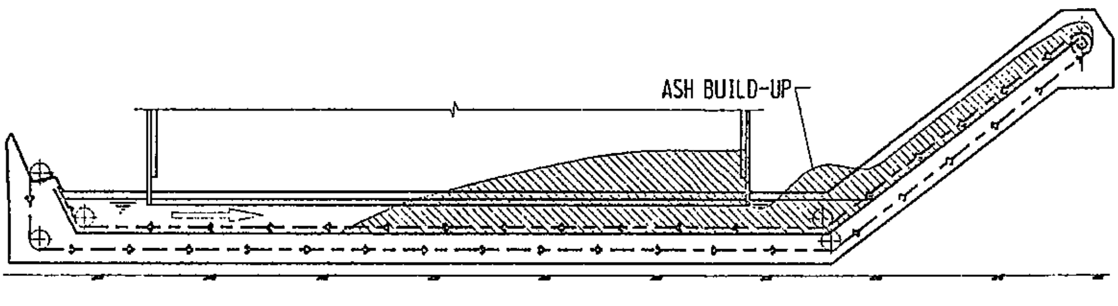
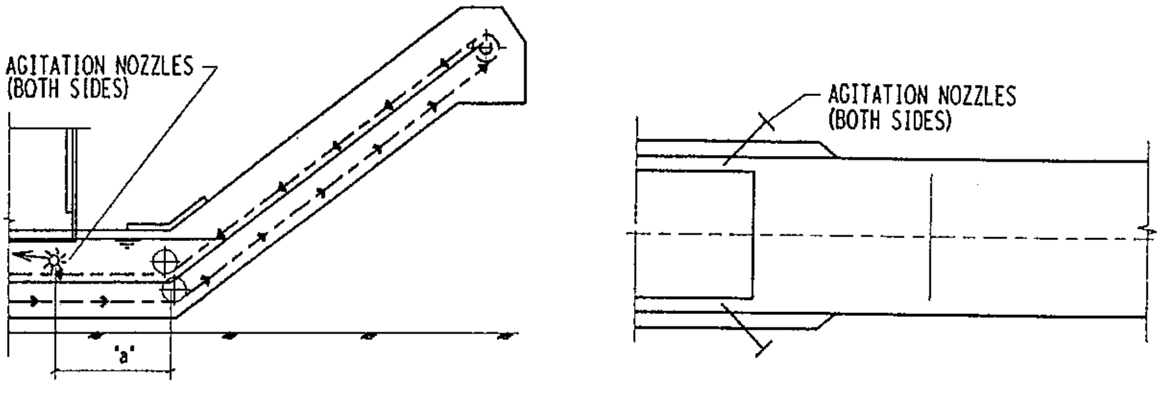


Fig 29: Matimba SSC - Backlog recovery without water agitation

6.2 Backlog Recovery with Water Agitation

Agitation nozzles were installed in the full-scale SSC. The location of these nozzles was determined according to the best results achieved with the scale model tests, ie nozzles pointing against the direction of travel of the chain, slightly above the top of the scrapers, with jets of water crossing towards the centre line of the SSC. The nozzles were installed just inside the boiler front dipper plate (Fig 30).



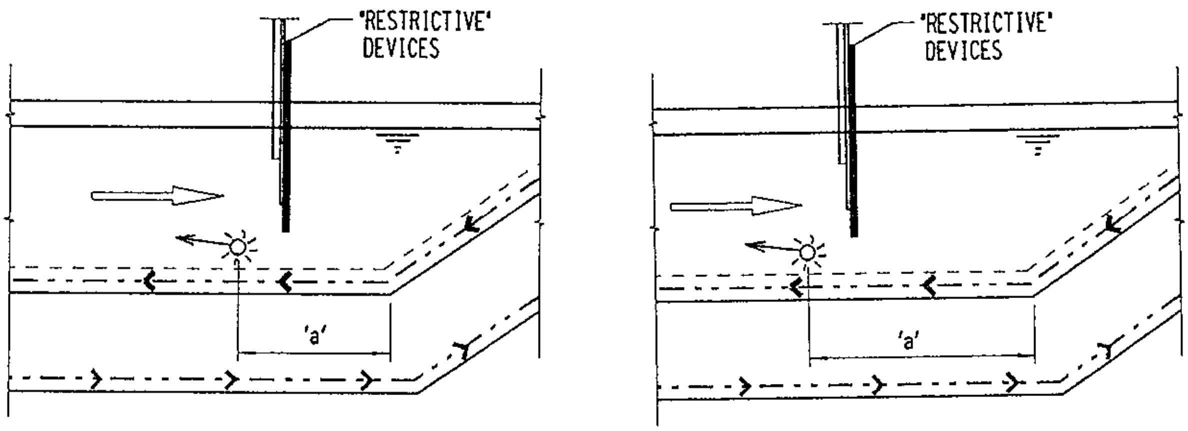
A: Side View

B: Plan View

Fig 30: Matimba SSC - Location of agitation nozzles

The SSC was stopped and a backlog (approximately 42 tons of "dry ash") was created inside the SSC. Note that the exact geometry of the 1/10 scale model was based on the SSC at Kendal Power Station and not on the SSC at Matimba Power Station. However for practical reasons existing at the time of the tests. The full-scale tests were performed at Matimba Power Station.

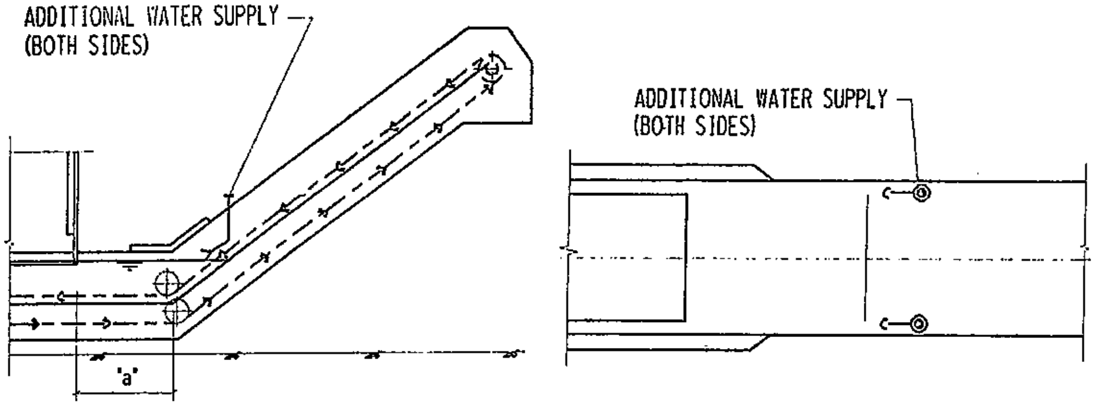
At Matimba Power Station the nozzles are located relatively far from the intersection point, as shown by dimension 'a' in Fig 31. due to the difference in the geometry of the SSCs of the respective stations. This increased distance on the full-scale SSC (Matimba) resulted in ash consolidation/settling in the horizontal section <u>after</u> the nozzles. The effect of this was ash build-up at the intersection point, similar to the ash behaviour without water agitation as discussed under item 5.1, and associated ash spillage over the side walls.



A: Kendal

B: Matimba

Fig 31: Geometry of intersection areas of Matimba/Kendal SSCs



A: Side View

B: Plan View

Fig 32: Additional Water Supply Points

Two additional water supply points were then installed towards the bottom end of the dewatering incline, above the SSC water line, as shown in Fig 32. The application of this additional water eliminated the build-up of ash at the intersection point by means of fluidisation of the lower layer of ash. This resulted in ash sliding back into the water bath, where adequate space existed due to the water agitation from the nozzles inside the front dipper plate. This combination prevented ash build-up at the intersection point and resulted in a situation similar to that in the tests performed with the scale model (Fig.33).

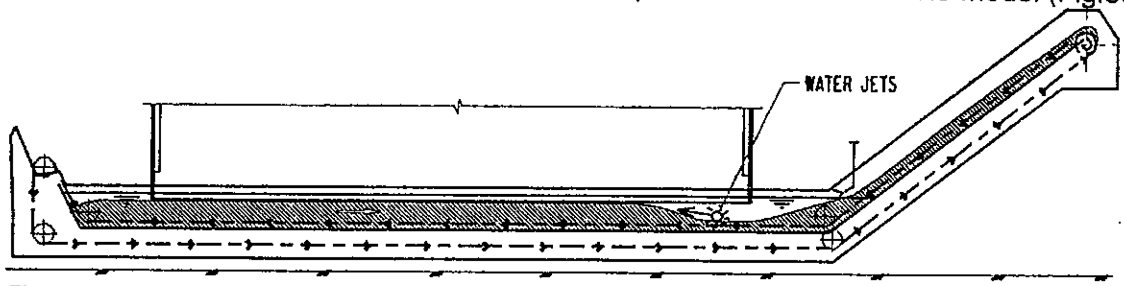


Fig 33: Matimba SSC - Backlog Recovery with Water Agitation

The best results from the tests performed on this full-scale SSC were obtained by utilising only one of the nozzles located inside the boiler front dipper plate for water agitation, combined with water supply to the two points at the dewatering slope above the water level (Fig. 32).

For these tests a water supply of 120 m^3/h at 3,5 bar was required at the agitation nozzle inside the front dipper plate and 1 m^3/h was required at each of the two supply points to the dewatering slope.

7. "EMPTY RUNNING" TESTS PERFORMED WITH THE SSC MODEL

The "empty running" tests were performed to evaluate the effect of chain tension and speed on absorbed power. Motor power was measured for the two types of scrapers (V type and Square type) with low and high chain tension settings and with increased chain speed.

7.1 The effect of Chain Tension on Absorbed Power

Motor power increases drastically with increased chain tension while operating at the same speed (Fig 34).

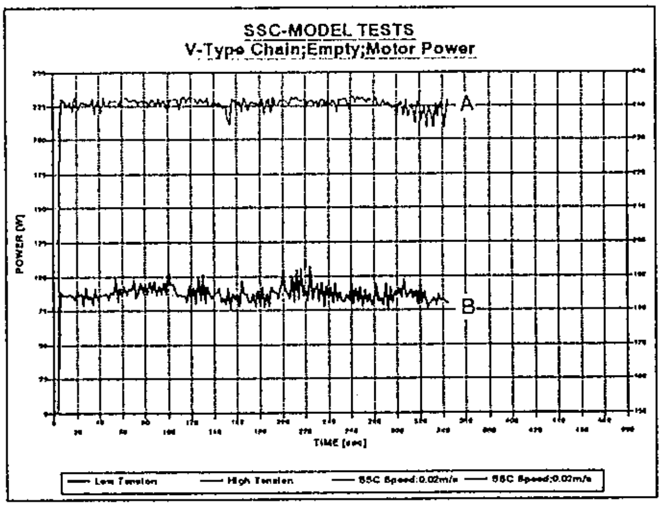
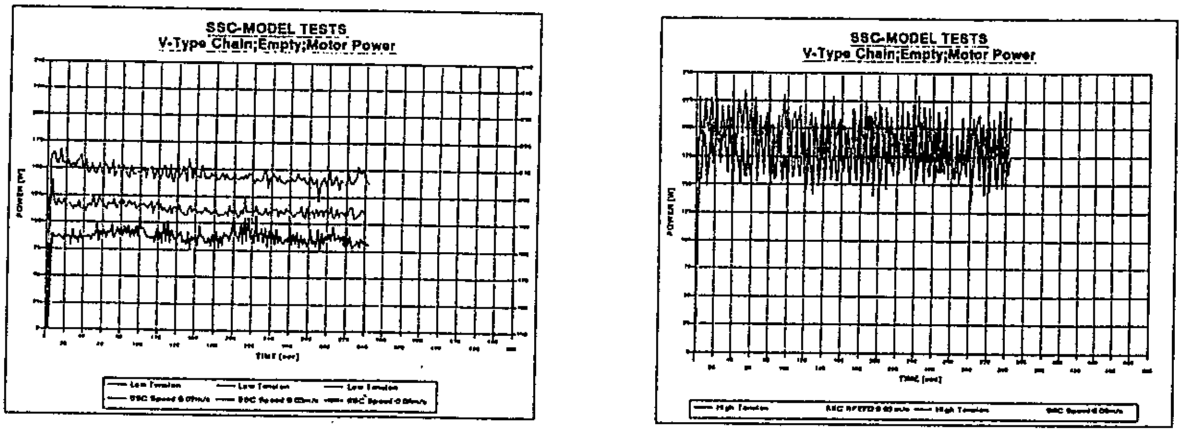


Fig 34: Effect of Chain Tension on Absorbed Power

The observed effect of chain tension on resistance corresponds with operational experience with SSCs. In certain cases where the installed power on an SSC is not sufficient for operation during backlog recovery, it is possible to initiate chain movement by reducing the chain tension imposed by the take-up arrangement.

7.2 The Effect of Chain Speed on Absorbed Power

Motor power increases proportionally with an increase in speed at a low chain tension setting, as shown in Fig 35A but remains relatively constant at a high chain tension setting (Fig 35B).



A: Low Chain Tension

B: High Chain Tension

Fig 35: Effect of Chain Speed on Absorbed Power

The high chain tension setting results in high system resistance. The effect of this resistance due to tension has a more significant impact on absorbed power than increased chain speed.

8. CONCLUSION

Very important information with respect to the material-handling behaviour of SSCs was gathered from this investigation.

This information is by no means final but will form the basis for further investigations and development of trends.

Two scraper types were tested, ie high-profile scrapers spaced at a relatively"long pitch" and low-profile scrapers spaced at a "short pitch". The low-profile scrapers at short pitch control the ash discharge rate better than the high-profile scrapers at long pitch. The low-profile type scraper option is also less sensitive to speed effects as far as load and spillage are concerned.

With the low-profile type scraper the ash loading is generally lower and more continuous on the incline section and the dewatering efficiency of the ash is also better due to the reduced load depth.

It is essential to be able to control the maximum ash discharge from the SSC during backlog recovery in order to ensure the cost-effective design and acceptable performance of the downstream equipment. The results of this investigation indicate that the spillage over the side wall of the SSC, as well as the maximum discharge rate and the driving power requirement, can be controlled by the use of water jets to agitate the ash.

Due to the positive results of model test work with the water agitation of ash in the SSC, the concept of water agitation has reached the detail development stage in Eskom.

A system has been installed on an SSC at an Eskom power station (Matimba) for further optimisation and performance evaluation. (See section 6 for results to date.)

The decision to select this option (water agitation) for further development, rather than other restrictive devices also tested with the SSC model, was based on the indication of better overall performance in respect of load control, dewatering efficiency, spillage control and the effect on power requirement in recovering backlog.

The "Restrictive devices" mentioned pose operational problems in the handling of oversize clinkers and the accessibility to SSC components due to the fact that a small opening is required for effective ash flow control.

It is also anticipated that water agitation can be implemented, and customised to a particular SSC, at a lower cost than the other "restrictive" devices discussed in this paper.

Acknowledgements

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