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DEVELOPMENT OF A SELF SLUICING PRESSURE LEAF FILTER

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The cylindrical Kelly filter presses installed in the Ewarton Works "C" phase did not perform satisfactorily because of difficulties with head seals, locking rings, and shell retraction mechanisms. As rectification required major modifications, a concept of a press which did not require to be opened for sluicing was proposed. Test work of various sluicing and reslurrying spray arrangements was carried out, and this led to the design of a self-sluicing press which used the shell of an existing Kelly press with its main axis vertical. One press was converted by July 1972, and a development period started. Although initial operation was encouraging, effective sluicing could not be guaranteed after 30 shifts. Modifications to leaf spacing, spray rotational speed, spray slot width, feed pressure and pre-coat control by November 1973, however, allowed effective performance for all of the 800 hour canvas life. Advantages are: reduced operating and maintenance manpower, clean environment, and reduced maintenance cost. The use of 1st wash overflow for sluicing has reduced caustic soda and canvas consumption. Ewarton Works now has four converted self-sluicing presses, and are converting five more, and Arvida Works plan the installation of one for tests on red pressing (blow-off filtration). A side benefit of the development was the study of the benefits of constant pressure overflow filtration.

Introduction

The original filters installed on Ewarton Works' press floor-where overflow filtration using lime pre-coat and filter aid is employed - were Bliss rectangular shell retractable head pressure filters of 2,000 square feet filtration area. These are robustly constructed machines which operate in the poor environment of mud and pre-coat scale reasonably well. When the plant capacity was increased in 1967-1968, Kelly type cylindrical retractable shell filter presses were added. Compared with the Bliss presses these proved complex and flimsy. Although the rectractable shell removes the problems associated with moving filtrate launders, the detailed arrangement of head seal, locking ring, and shell retraction mechanism did not work well with resulting low equipment availability and high maintenance cost. For three years following the installation of these presses, a number of modifications were attempted: the hydraulics were simplified; larger locking rams installed; alignments checked; seal designs changed; and preventive maintenance routines intensified but all with less than satisfactory results. The situation was such that heads were being opened using the press floor crane, a sling, and heavy sledge hammering: and shells retracted, using pull-lifts. Head seals lasted about sixty days and cost $300. each. It then became obvious that major changes would be required to the entire head support and closure mechanism. In considering this conversion, and its cost, the reasons for the head locking and shell retraction were reviewed. These exist so that the press can be opened and closed quickly for dumping the mud and spent pre-coat - in Ewarton's case every 7 or 8 hours. It was thought that perhaps there might be a way of sluicing the residue off without opening the vessel. The idea of permanently mounted fixed hosing nozzles above the screens was considered.

However, an enormous amount of hosewater would be required to operate all simultaneously, and a large number of valves would be required to operate them in sequence. In any event, the nozzles would always be blocking up. A moving spray was more likely to be successful, so a simple spray header was made up to observe the results. After a number of failures, a spray header was developed which worked. It was 45" long with a 1/8" slot and had a plenum chamber with baffles to give an even jet. To test this arrangement, one of the Bliss presses was dumped using this device slung from the press floor crane and connected to four dump hoses. The simplest way to move a spray of this type is to rotate it, so the plan view of the area to be washed is a circle. As the elevation of the Kelly presses is a circle, a press turned on its end with a rotating spray in the top

was a feasible idea.

Conversion Description

A Kelly press had been damaged beyond use as a conventional press and was relinguished for use as a test press. In order to ascertain if the residue could be removed from a press turned on its end, an open topped box with a sloping bottom and central hole was devised. By catching residue from under a press as it was opened, an annular jet arrangement was developed that would reslurry the residue. A set of sketches was made up to convert the Kelly press to self dumping. The conversion description reads as follows: (Readers may find it helpful to refer to attached Figures 1 and 2).

SHELL: The track, carriage, head, and hydraulics of the existing Kelly filter are removed. The shell flange is cut off. The shell is fitted with four feet, turned on it's end, and fitted on the existing filter support beams. A central outlet is fitted to the dished end, and the manhole cover converted to take a relief line. Platform supports are fitted.

PLATFORM: The platform is designed to fit over the shell and rest on the platform supports so that it does not tend to pull out the filter sides. The deck and handrails are prefabricated, and sized, so that they will line up with any other filters that are converted. The platform can be used to complete the rest of the press conversion.

SHELL TOP SECTION: This section is purchased from an outside supplier, and is post-weld heat treated because of the flange thickness. It is made to slip over the shell, and will be attached to the shell by double fillet welds. It includes the spigot outlet pipes and leaf supports. The flange is designed for 75 psi pressure, and has 36 X 1-1/4" D UNC studs to hold it to the head.

DISHED HEAD: This is also purchased from an outside supplier. The flange contains a groove to take the same gasket material as the Bliss Filters. Three lifting lugs are fitted for removing the head by crane, for leaf redressing. A central outlet supports the spray arrangement.

LEAVES: Two requirements prevailed over the design. All leaves were to be the same size, and were to be covered by 62" wide cloth (cloth size in use at that time) with minimum sewing and waste. This has been achieved by using 22 leaves at 3-1/2" centre to centre spacing, 48" wide, and 10'3" long (dictated by crane headroom), which gave a nominal filtering area of 1800 square feet. The leaves contain channels at each side to allow a free flow of filtrate up through the leaves.

SPRAY ARRANGEMENT: The spray has been designed to be as light as possible, consistent with test work findings. It is a 48" long 1/8" wide slot, fed from a 3" pipe.

A special rotary union has been purchased to transmit hose water to the spray.

The spray will be rotated by an air motor through a 60/1 worm reducer, giving a rotational speed adjustable between 5 and 30 r.p.m.

The air motor, reducer, and union will be mounted on a pedestal, which incorporates a steady bearing to protect the union from damage when the spray wobbles during head removal procedures for leaf redressing.

BOTTOM END PIPING: The reslurry jet is fitted above the bottom outlet. The filter is fed through the outlet to keep it clear for dumping.

Development Modifications

After the initial installation, problems arose. Primarily, the need to determine if the press was clean. Sampling of the sluiced material was attempted, and then an inspection valve was fitted.

Problems of hosewater supply arose, since the self dumping press would monopolize the hosewater while dumping, leaving little for the operators to manually hose the remaining conventional presses. This was solved by installing separate wash and dump pumps, and using first stage mud wash overflow to dump with, returning the residue to the same stage. The spray was rotating too fast to clean all the way to the bottom of the screens, so an additional reducer was fitted, to reduce it from five turns per minute to one turn every four minutes. The filter cloth hardens

as it ages, forming liquor bags at the bottom impeding the sluiced material from reaching the bottom outlet. To ensure reliability during the testwork, every second leaf was removed leaving a 7" centre to centre spacing. It was also discovered that, as well as forming an easily sluicable residue, the overall filtration rate was increased if the feed pressure was limited. An optimum feed pressure was ascertained, and a pressure control valve was installed in the feed line, which served to prevent the filtration pressure from rising when, for instance, an adjacent press is taken off service.

The special jet designed to reslurrying lumps near the outlet in fact hindered the emptying of the press. The jet was removed, allowing the lumps to leave the vessel and be pumped away.

The spray slot frequently blocked with scale particles so that the leaves were not properly cleaned; a strainer was fitted in the line, and the slot width increased to 3/16".

In order to make the apparatus easy to operate, the instructions were simplified. The spray is left rotating at all times. The dump sequence is:

1. Close liquor supply valve;

2. Open press dump valve; start dump pump;

3. Start press wash pump; open press wash valve;

4. When press is empty, open inspection valve; if clean stop wash and dump pumps.

It can be seen that the washing starts before the press is empty. In fact, the press is usually clean by the time it has emptied, in 5 to 10 minutes.

By November 1973, the press was working reliably. In that same month the adjacent press had been converted and put in service, and in April 1974, two more self-sluicing presses were commissioned. All four are presently operating, and used in preference to the remaining Kelly presses. The inspection step is now omitted and the presses are only opened every 35 days, for 8 hours, to redress the screens with new filter cloth.

Ewarton Works is now going ahead with the conversion of five more presses, enabling the complete disuse of the Kelly type filter press.

Facts and Figures

The original estimate of the conversion cost for the initial press was $14,700. With the subsequent modifications, primarily the addition of a separate wash and dump pump, an estimate of the real cost would be around $25,000. The next three press conversions, which took place 18 months later, cost $33,000. each. The next five, estimated to be installed during 1976, should cost $54,000. each, including pumps, control valves and an additional screen washing tank. The original press contained 890 square feet capacity after every 2nd leaf was removed; the next five to be converted will have 1,254 square feet filtration area, due to a modification in leaf spacing and arrangement. Filtration rates compared very well with the conventional presses, in spite of a much lower overall filtration area. This can be explained as follows:

1. Filter cloth on self dumping presses receives a more thorough washing and remains soft and moist, since it is not exposed to air during sluicing.

2. Press availability for the self dumping presses is much greater, averaging 95% or above.

As a result of the cloth remaining hot and moist throughout its life and receiving a more thorough washing, cloth consumption has been reduced to about 55% of manually dumped presses.

With this totally enclosed vessel, elimination of leaks from head locking mechanisms will result in more than $100,000. per annum savings in reduced chemical losses. Improved housekeeping and an overall cleaner environment is another benefit with this type of unit.

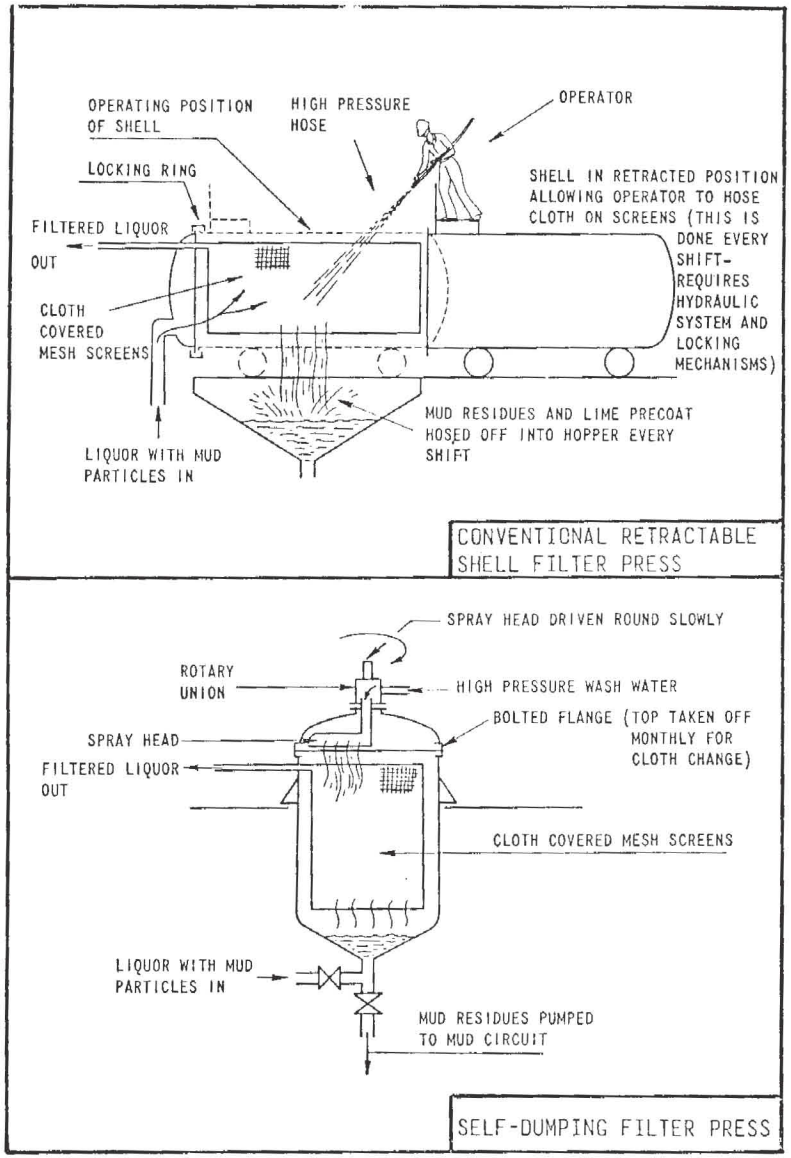
Manpower savings in the filtration area will amount to a 30% reduction in the workforce, even considering the necessary addition of an electrical and instrument maintenance man for the extra instrumentation. Maintenance material savings of $50,000. per annum is also expected with these relatively maintenance-free presses.

Arvida Works are presently engineering a 10' diameter 2,000 square feet capacity self dumping press, for testing with their filtration conditions. The newly designed press will eliminate any restrictions caused by the use of existing Kelly press shells, as was the case at Ewarton Works'.

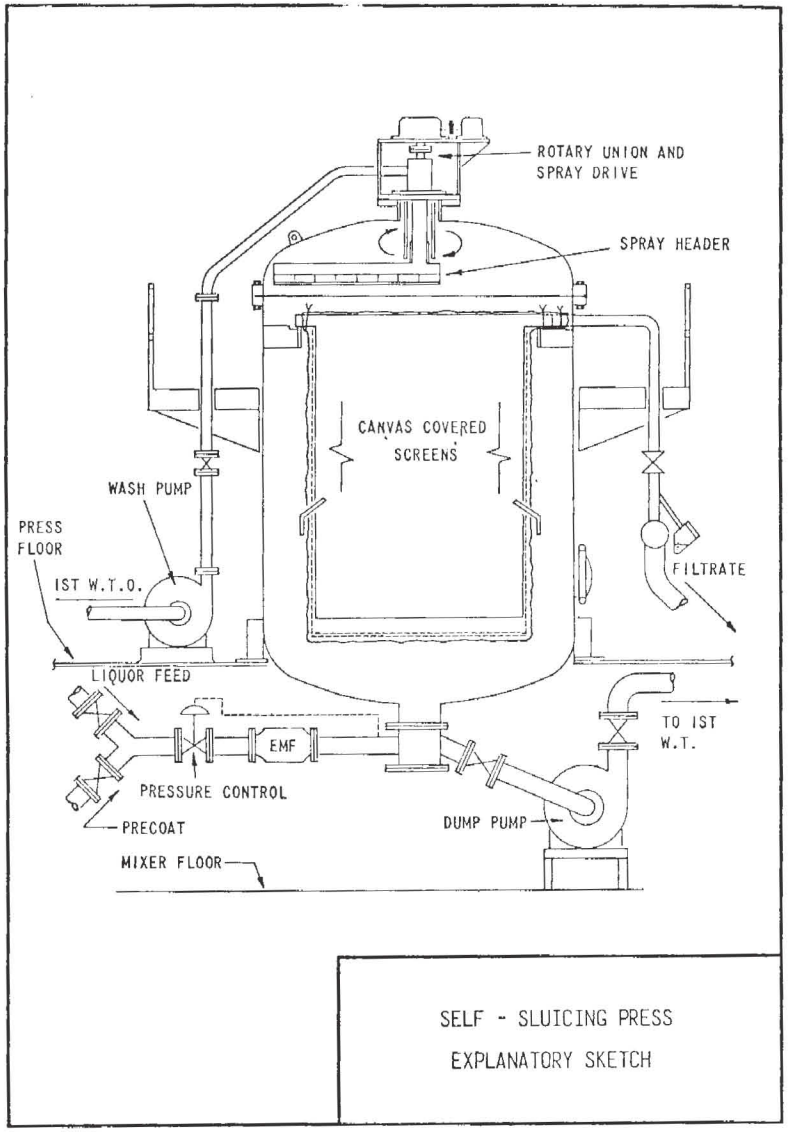
Conclusion

This conversion is attractive to existing plants operating overflow filtration, as it can be carried out without major changes to building structures, piping systems, etc.; and is inexpensive.

Full automation of the press is a relatively simple additional refinement, requiring only a timed valve-sequencing apparatus. The press could be adapted to any industry requiring the separation of a solids-liquor mixture, by means of pressure filtration.



Comparison of Conventional vs Self-Sluicing Pressure Filter Operation



SELF - SLUICING PRESS
EXPLANATORY SKETCH