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AUTOMATION OF METURLLURGICAL PLANTS TO REDUCE PRODUCTION COSTS BY 50%

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PRESENTATION OUTLINE

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ABSTRACT/SUMMARY

- This work reports on the modification of metallurgical processes by means of automatic control of drain valves, suction valves and flushing of suction lines to completely eradicate line chokes and sanding of slurry pumps.
- These modifications have been performed on several metallurgical plants across the country with resounding success.
- Automation removes human error, delayed operator action in plant operation and enables the metallurgical process plants to save over 50% on both maintenance and production costs as well as eliminating loss of production due to prolonged plant downtime.

INTRODUCTION

- For a very long time many metallurgical plants that treat slurries have been experiencing line choking as a result of using manual drain valves and manual line flushing owing to the extra costs associated with automation.
- Furthermore, this was considered as a less critical process control operation hence, not worth the high cost of automation but since this automation is by far cheaper than manual control it justifies why it was essential that it should be done.

- Every time a slurry pump is switched off or trips off, the operator has to rush to manually open all the drain valves to prevent choking. However, operator delays lead to settling of the solids which eventually results in choking the lines and sanding of slurry pump housings.
- In worst cases pumps, drive motors, VSDs, vee belts or drive mechanisms may be damaged as the operator attempts to restart the plant without draining or unchoking the lines.
- Depending on the size of the pump, extent of damage or choking, it will lead to prolonged hours of production loss, increased maintenance costs as well as high overtime costs in order to restore plant operation.
- Figure 1 displays a flooded area in a concentrator after delayed operator intervention leading to flooding of the area.

Figure 1: The photo displays a flooded banded area at near a flotation column before modification **(**ZIMEC (2023))

- The process modification involves automating the opening of drain valves, suction valves and water flushing of suction lines to ensure immediate automated response when need arises. This removes human error, delayed response in plant operations and thereby resulting the following benefits:

1. Complete elimination of down time associated with line chokes and pump sanding; reduced maintenance costs since this automation will prevent the frequent premature pump failures resulting from chokes.

2. Full lifespan of pumps will therefore be guaranteed; reduced production costs as there will be no requirement for extra labor or overtime for unchoking lines and attending to breakdowns; increased efficiency of operation and maximizing on production since frequency of plant stoppages will be minimized.

3. This will result in increased profitability

Figure 2: Clean banded area after process modification with auto flush **(**ZIMEC (2023)**)**

- Figure 2 displays the working area previously shown in Figure 1 after installation of the automated valve system.

- As seen from the Figure, spillages and thus downtime is completely eradicated leading to a clean and safe working area and savings of man hours and costs for the plant.

METHODOLOGY

- Since this was new technology on the market, there was need to convince the industry about the efficiency and success of this invention.
- The mining industry players were not willing to spend money on unproven technology.
- The strategy therefore involved free installation and free plant trials on selected plants with the understanding that payment would be made once they were satisfied with the results.
- As a result of the visitations and presentations made to different mines, plant trials were successfully undertaken in seven different plants as shown in Table 1.

PLANT TRIALS LOCATIONS (Table 1)

Item	Mine Site	Process Plant	Installation	Year installed	Life (Years)
1	Chambishi metals	Smelter plant	Slurry level tank control	2008	Plant down
2	NFCA	Old concentrator	Copper column froth level control	2009	To date
3	KCM, Konkola	Concentrator	Slurry drain/water flush	2016	To date. doing the whole plant done 30% done so far
4	KCM, Konkola	Concentrator milling plant	Slurry drain and suction automation	2016	To date. doing the whole plant
5	KCM, Nchanga	Old concentrator	Slurry auto drain	2016	To date resolved to do the whole plant
6	Chambishi Metals	Roaster plant	Slurry drain/flush	2017	Plant down
7	Mopani, Nkana	Old concentrator	Copper column auto water flush	2017	Plant down after 2 years of running
8	KCM, Konkola	Concentrator	Slurry drain and auto water flush	2019	To date, doing the whole plant
9	KCM, Nchanga	Tailings Leach Plant	Slurry auto drain	2019	Removed after 2 years because of unreliable instrument air supply
10	Mopani, Nkana	Sync concentrator	Slurry auto drain	2022	To date, doing the whole plant

RESULTS AND DISCUSSION

- The plant trials were very successful as shown in Table 2. All the plants were very satisfied with the results and in many plants the results exceeded expectation as follows:
- The immediate activation of draining and flushing of lines completely eliminated line chokes and pump sanding; the units operated successfully without any chokes/sanding, hence no related pump breakdowns; there were no plant shutdowns associated with line chokes/pump sanding; in all the plant trials the life of the valves/sleeves exceeded the conventional ones; the plants were able to make payments after successful trials and most of them even made further orders for more installations and resolved to automate all their process plants.
- Figure 3 shows a Copper Column flotation cell before modification with an automated system for one of the clients.

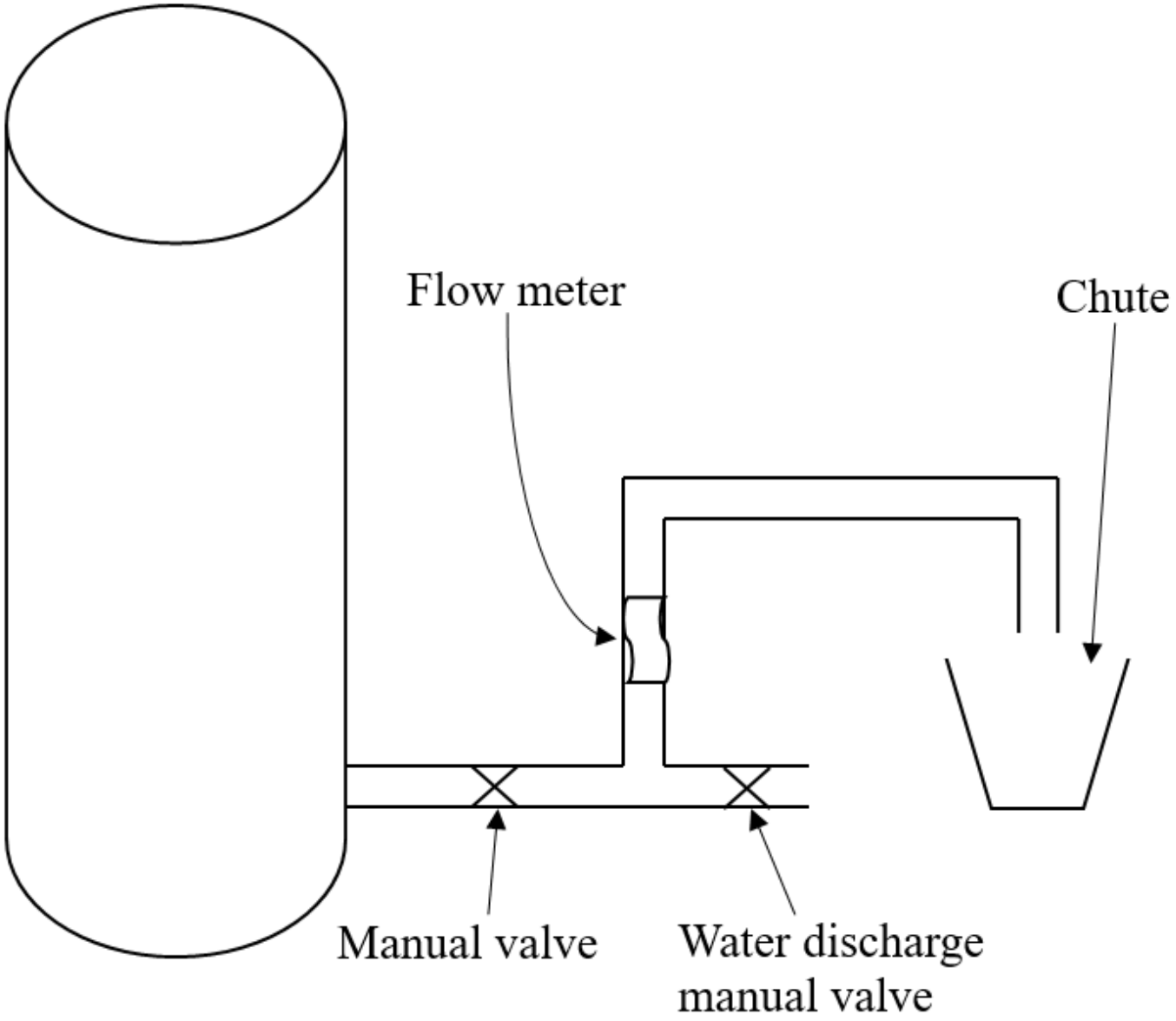

Figure 3: Copper column cell before installation of automatic control

CONT'D

- As aforementioned such a manual configuration resulted in downtime and other challenges previously discussed. Figure 4 displays the automated control loop of the same unit upon modification with the automatic control valves. This modification resulted in a reduction in the downtime from 48 hours to a merely 60 seconds, i.e., a staggering 99.97 % in terms of plant availability.
- The reduced downtime is easily observed from the control room display of the tails flow rate as shown in Figure 5. The low-level limit flow rate is set to 500 m3/h. When the system starts to choke the tails flow rate quickly decreases and when it reaches the low-level limit the controller signals a backflow flush which clears the line. This means that this automation detects and clears the impending tails chock within 60 seconds as opposed to the long hours it used to take operators to un-chock the tails every time they got chocked.

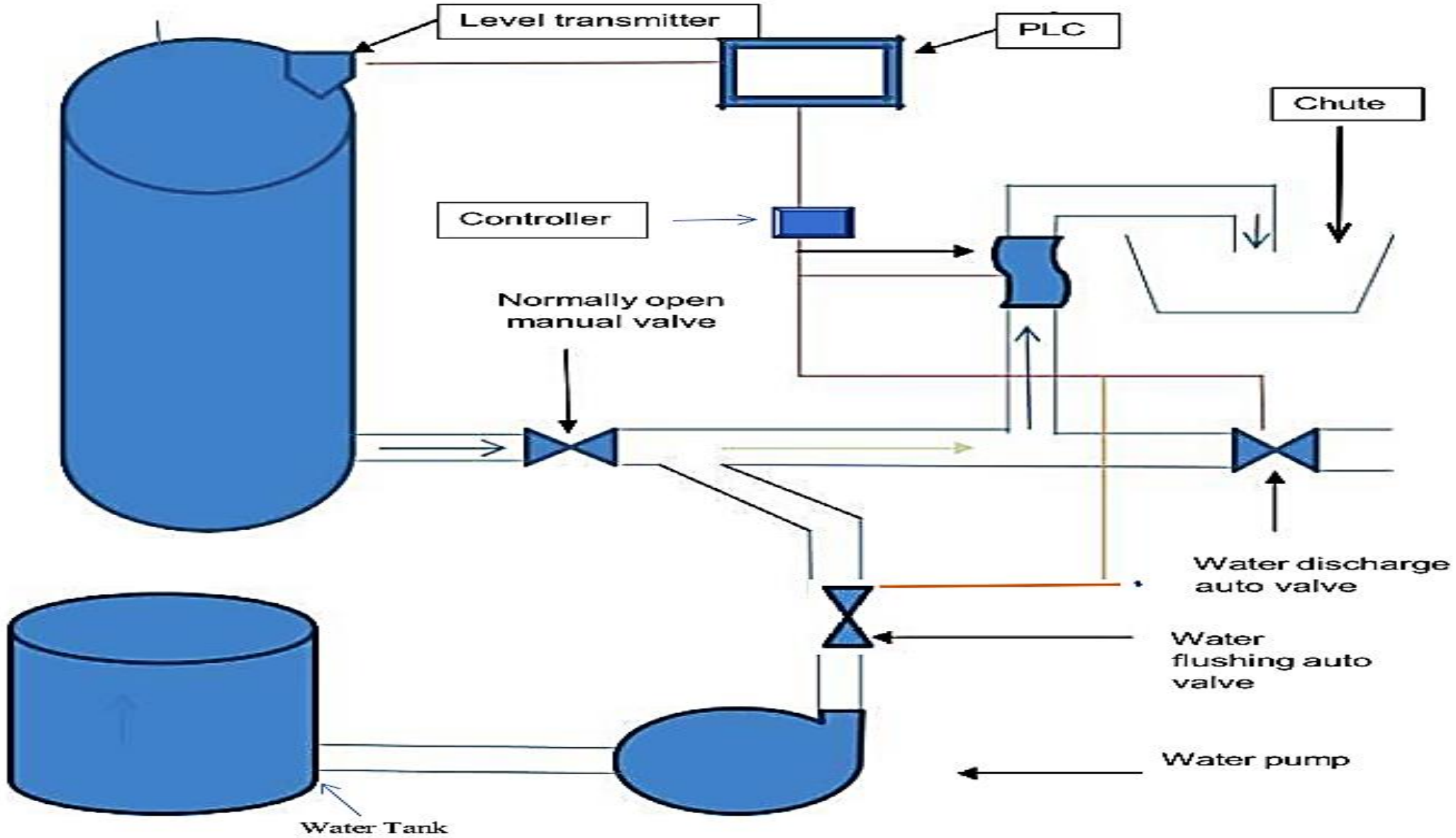

Figure 4: Automated flush design for copper column cell

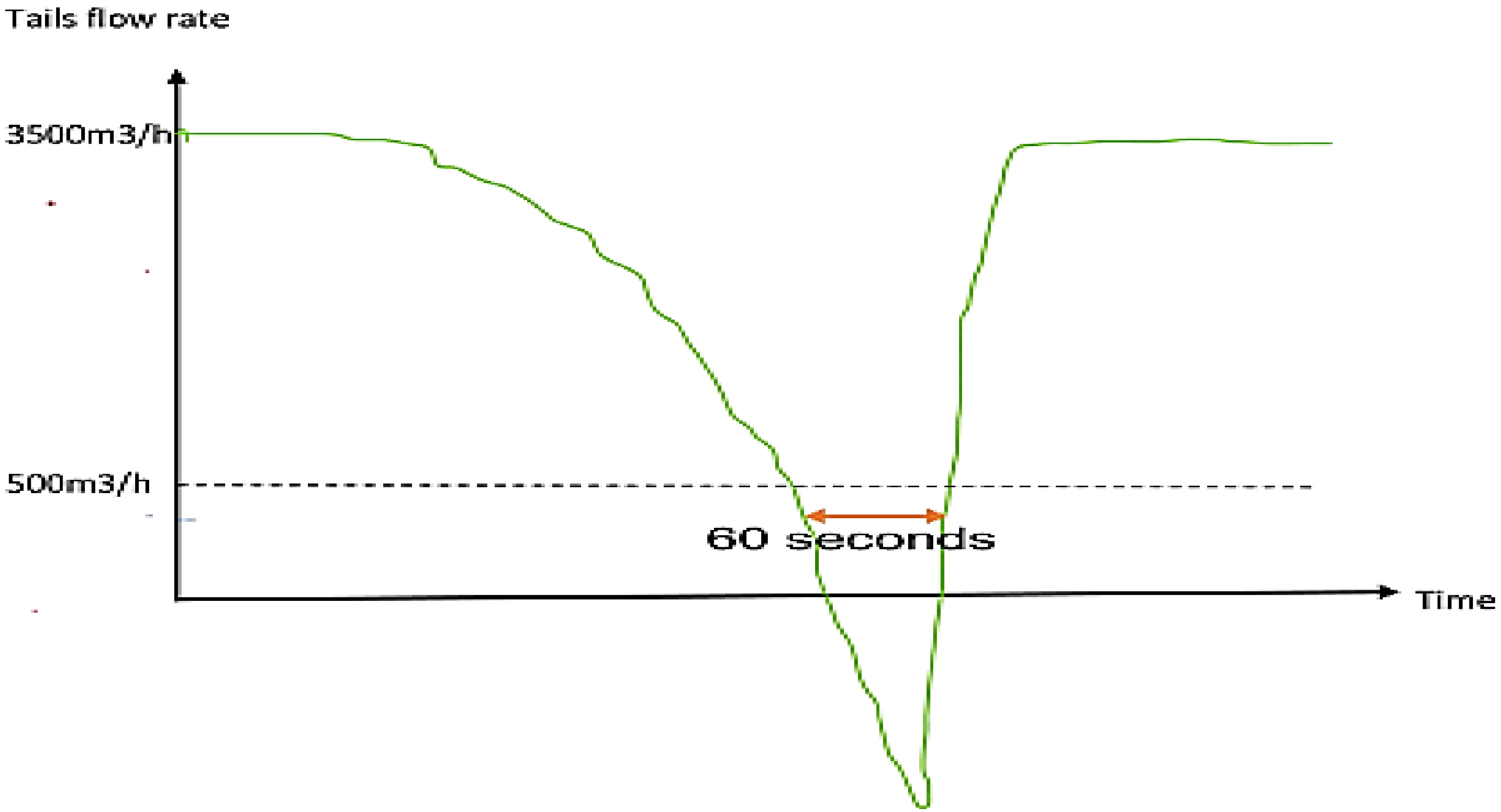

Figure 5: Trend for controlled variable (Tails flow rate) for column installed with automatic valve.

CONCLUSION

- The overwhelming success of the plant trials shows that the plant modifications by automating the opening/closing of drain valves, suction valves and water flushing of delivery lines results in immediate automated response resolving the challenges of line chokes and pump sanding with the accompanying benefits of increased plant availability, utilization and reduced maintenance/production cost.

- This automation intervention was applied for a client's copper column cell and it managed to reduce downtime by nearly 99.97 % for over two years.

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Certificate of lodging application for a patent for an invention dated 20.01.2022 Patent application NO: 1/2022.

The End

Thank you for your attention