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Subject: Gap Checking Trial Using Plasticine and C-Gap

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Ref:

1 Summary

Two new materials in obtaining the close side setting (also known as crusher gap) of the crushers were evaluated. On the Primary Crusher, the current materials being utilized is an aluminium shaped cylinder (made from aluminium foil, trays and a lead weight) while the cone crushers utilizes only the lead weights. The evaluation looks both the economics and operational ease of the new materials comparing this to the incumbent method.

The tests also draw the base data of the close side settings for all the crushers with new mantles and liners in place.

2 Context and background

The close side setting is the minimum distance between the mantle and the concave liner. This distance also approximates the final product size of the crusher. The Hydroset system for the crushers allows the mantle of the crusher to be moved vertically allowing adjustments on the gap when required (e.g. if product is too coarse, mantle height should be reduced thus reducing the crusher gap).

For the cone crushers, calibrating the Hydroset is essential to maintain desired product size. In order to do this, the gap should be manually obtained using materials that are mouldable and retrievable for reading. The DCS gap indicator is then calibrated against the manual reading.

Constant monitoring of gaps can also give an indication on the liner wear of the mantles. The strategy change for the primary crusher mantle replacement will benefit from a more accurate reading as the current aluminium materials posed a significant complexity in preparation and retrieval of the material and tend to be unreliable due to the expansion of the foil after retrieval. It also contributed to some occasions of belt trips leading to fine crusher shutdowns due to metal detection on CV03.

A trial was implemented looking at the data credibility of C-Gap device reading and the plasticine as replacement materials.

2.1 C-GAP

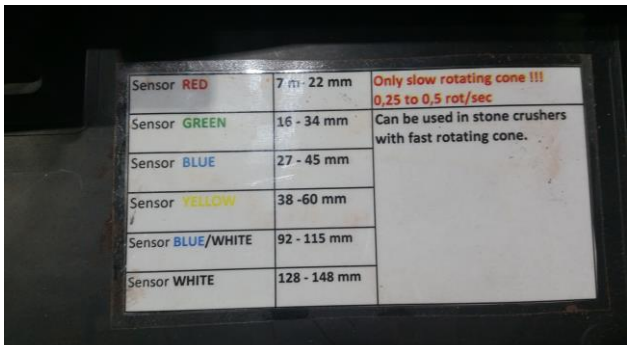
This unique device comes from Germany and solely built for the purpose of getting the close side setting on crushers. Mintap is the licensed distributor here in Australia as the device has only been recently launched commercially.

The unit is composed of bulbs in different sizes (for varying gap range from 7mm to 220mm), a hose and a handheld device. All three components were connected to each other. The bulb is thrown into the crusher nipping area and the amount of air displaced is measured and converted into a gap reading readable on the handheld device. The bulbs were claimed to last a minimum of 12 months with normal use.

A calibration needs to be done prior the use of the equipment. As such a reading from either plasticine or preferably lead weight should be obtained in parallel with the C-Gap. An offset value is then placed on the handheld device.

Below is a photo of the trial unit:

The bulbs available for the trial units are below:



2.2 Plasticine

This material has been tested on the cone crushers and evaluated to be a failure due to inability for the material to be retrieved. The test failed due to the procedural error on preparing the material. The procedure was revised ensuring that the plasticine can be retrieved and be measured afterwards. Attached in the appendix is the revised SOP for the plasticine.

2.3 Expected Results

There will be no base data for the gaps of the primary crusher as the gapping done using the aluminium were inconsistently and unreliably reported over the last production year. It is foreseen that using the plasticine, a base reading for a newly relined primary crusher will exhibit a data with a proportional relationship between the close side setting and mantle gap.

After calibration of the cone crusher's DCS gap indicator, the C-Gap and plasticine should have a reading with a +/- 2 mm tolerance against the DCS.

3 Observation and Analysis of Trial Data

3.1 Primary Crusher

PRIMARY CRUSHER BASE READING

Mantle height (mm)	Close Side Setting (mm)
230	91.28
200	83.75
160	79.75
120	70.8
80	60.58

The data above was obtained via plasticine. Mantle gap corresponds to the expected mantle height. Unfortunately, the required sensor/bulb size was not available with the C-Gap trial unit in order to undertake the trial on the Primary crusher. The manufacturer confirmed that they can provide the required sensor/bulb for Primary crusher calibration in the case ERA decide to purchase the unit.

3.2 Secondary Crusher

Prior to obtaining the CSS, the crushing gap indicator on the DCS was calibrated using the old method of lead weights. As such, the following summary tables treat the DCS and lead weights to be the true value

Trial 1 - Secondary Crusher

Material used	Close Side Setting (mm)	%error
lead weights / DCS reading	29.5	
Plasticine	nil	nil
C-Gap	35	18.64

Trial 2 - Secondary Crusher – after calibrating C-gap

Material used	Close Side Setting (mm)	%error
lead weights / DCS reading	29.55	
Plasticine	32	8.29
C-Gap	30	1.52

The DCS setpoint was 30mm and as shown the C-Gap performed best on trial 2 after calibration while the plasticine exhibited the maximum allotted difference for the test. The plasticine wasn't able to be nipped properly on trial 1 due to the mantle spinning out relatively fast.

3.3 Tertiary Crusher

Trial 1 - Tertiary Crusher

Material used	Close Side Setting (mm)	%error
lead weights / DCS reading	16	
Plasticine	17	6.25
C-Gap	18	12.50

Trial 2 - Tertiary Crusher- after calibrating C-Gap

Material used	Close Side Setting (mm)	%error
lead weights / DCS reading	16	
Plasticine	16	0.00
C-Gap	16	0.00

Both the C-Gap and plasticine were able to check the gap properly on the tertiary crusher and that there was no disparity on trial 2 against the true value for both materials.

3.3 General Observations

i. C-GAP

The main issue is the short cable attachment of the bulb leading to a high tendency for the thread fitting to be crushed. The latter happened on the red bulb (smallest sensor) upon using it on the tertiary crusher. Supplier was notified and has modified the smallest sensor to include a protective ball around the coupling which is larger than the open side setting thus preventing the coupling entering the 'nipping' point.

Measuring smaller gaps needed to use smaller bulbs, thus the lesser the tendency for the bulb to be nipped properly due to its lightness, especially if the mantle is spinning at a high rate as in the case of the secondary crusher. Supplier will look at the feasibility of addressing this but does not guarantee of any change. A review of the SOP might also address the following (e.g. throwing some rocks to slow down mantle and getting the gap on one end or measuring upon crusher start-up when rotation is slow). The supplier notes that measuring small CSS' (less than 9mm) requires a slow rotating bowl.

Operators perceived the C-Gap as easy to use as the instructions were straightforward. They also had commended on its safety advantage over the lead weights.

ii. Plasticine

Following the change in the preparation of the material, the plasticine performs exceptionally on getting the gap on the primary crusher, though an extra work should be done in remoulding it into its original shape.

The difficulty on fast spinning mantle mentioned for the C-Gap on the secondary crusher was also experienced while using the plasticine.

No issues were observed for the tertiary crusher.

4 Conclusion and Recommendations

The C-Gap and plasticine have both passed the accuracy test, highlighting that it did not made an error on the 2nd trial for the tertiary crusher. This paper endorsed the reinstatement of the plasticine as the material to be used for gap checking for the immediate term and strongly suggest the purchase of the C-Gap following the cost saving entailing the latter. The C-Gap will be beneficial on monitoring and strategizing the mantle replacement on the primary crusher.