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STUDY ON THE REDUCTION OF WATER USED FOR MATERIAL HANDLING DUST SUPPRESSION

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Introduction

Benmarc has been actively providing wet dust mitigation solutions to the South African Mining Industry since 1997. Even at this early stage, the objective was to minimize the amount of water required to curb emissions to an acceptable level. However, the water crisis has since worsened due to pollution and drought to the point where key economic operations such as the mining industry has come under threat.

The available water fit for human consumption in the Northern Cape has declined systematically over the years. The regions full revolving capacity is 146,300,000m^3, whereas in 2018 the actual revolving level was measured at 81,000,000m^3.

To this end Benmarc has invested in the research and development of sustainable chemical dust suppression systems and processes to support the effort of reducing resource consumption such as water and energy.

A key consideration is the improvement of the dust suppression chemicals to increase the ability of water to spread over dry surfaces. This then reduces the amount of water needed to suppress the forming of airborne dust particles during mining operations. Since early 2016, Benmarc has invested substantial funds with international bodies to research and develop a more effective chemical for the purpose.

Objective

In line with the worldwide concern regarding the availability of water, the ultimate objective is to reduce the amount of water needed for effective dust control on material handling systems without increasing the amount of chemical addition and maintaining bio-degradability.

Approach

Benmarc embarked on a mission to research and develop a more effective chemical that would require less water to effectively suppress dust. Once the chemical could be produced on large scale, the testing on real-world situations would follow.

Research and development

Several institutions were involved in sourcing and perfecting a chemical compound that would outperform the original BM515E and BM210E currently in use.

In order to short-list possible solutions, initial testing in the USA focused on the time it took for super fines to drop to the bottom of a glass filled with water/chemical mixture. This would indicate the level of the ability of the solution to wet surfaces.

Following the preliminary testing, The Mine provided a batch of fines for further laboratory evaluation using European and Australian standards to determine if a reduction in the “dust number” manifested itself with the application of the new chemical compound.

Where it has been proven that 7.8L of water (no chemical) is required to suppress the dust generated by one ton of ore (tested on iron ore), the original chemical has reduced the need to just over 5L/ton. Benmarc successfully applied this chemical since the early 2000’s and it is still being used widely at Iron Ore Mine and Manganese Mines in the Northern Cape area.

The latest development has shown an even further reduction in the need for water to the tune of 0.5L/ton. Although this does not appear to be a significant reduction, the figure should be extrapolated to reveal the annual saving across the entire operation.

To support the encouraging laboratory results, field testing was required to ultimately prove or disprove success.

Implementation

The actual implementation has financial impact as the nozzle sizes must be changed in order to reduce the discharged water. Therefore, it was decided that the initial test be conducted at a single site. The mine uses more water per ton of ore for dust suppression compared to the other installations due to the periodic use of the water canon at the stockpile and was chosen as the site for the initial test.

The new chemical is 100% compatible with the old chemical and therefore mixing the two during offloading presented no risk of a negative impact on the suppression effort or otherwise. The altered chemical was slowly introduced at themine from the beginning of February where it was initially mixed in with the original chemical remaining in the tanks. The original chemical has since been depleted and only the new chemical has been in use since the beginning of March.

In order to test the effectiveness, several spray nozzles were changed out to reduce the water addition while the chemical addition remained unchanged. At the same time, the emissions during stacking were visually observed over a period of the two months since the introduction of the new chemical.

Monitoring of water addition

Benmarc monitors the water and total moisture added to the material stream closely as part of the deliverable functions and reports this at the monthly meetings. Therefore, historic figures are readily available.

Results

The take-off point for the stockpile water canon is located after the water flow meter and therefore the frequency of utilization of the canon must be considered.

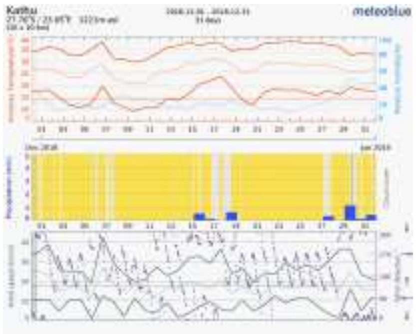
Even though no record is kept of the use, it is a logical deduction that, the higher the rainfall is during a specific month, the less the water canon would be used. For reference, the weather graphs are presented below. For clearer pictures, please refer to the relevant monthly reports or visit the internet source –

https://www.meteoblue.com/en/weather/forecast/archive/kathu_south-africa_991664?fcstlength=1m&year=2018&month=1.

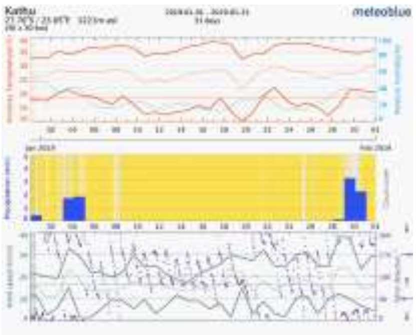
Weather Report:

October 2018
(Old Chemical)

November 2018
(Old Chemical)

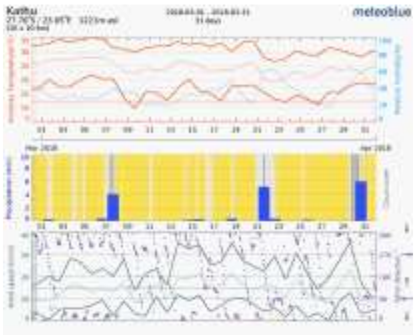


December 2018
(Old Chemical)



January 2019
(Old Chemical)

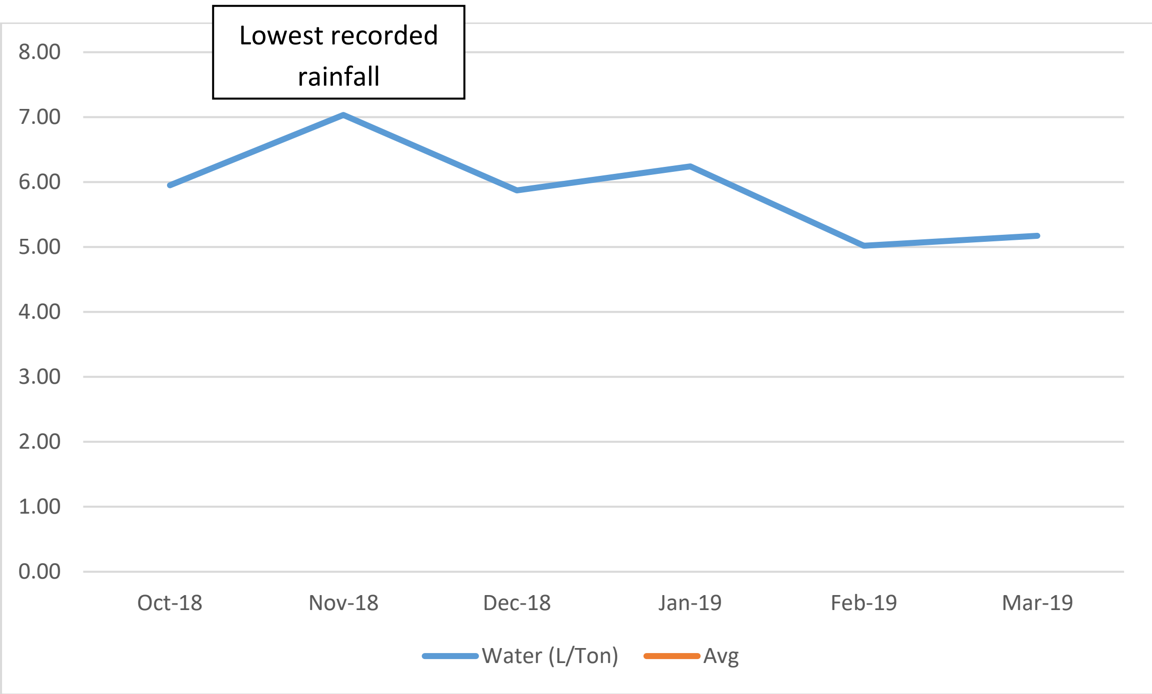
February 2019
(Old/New Chemical)



March 2019
(New Chemical)

Water consumption for the same periods:

2018	October	5.940 L/Ton
2018	November	7.034 L/Ton
2018	December	5.873 L/Ton
2019	January	6.244 L/Ton
2019	February	5.020 L/Ton
2019	March	5.175 L/Ton



Monitoring of dust levels

The primary focus remained on the emissions during discharge onto the stockpile. Because the discharge point is out of reach, visual observation was chosen as the method of evaluation. No visual changes in emissions were observed.

Discussion of results

The data presented herewith is merely a periodic snapshot and does not necessarily reflect the future water savings as a result of the initiative.

The lowest rainfall was recorded in November and December of 2018 and the water consumption due to the usage of the canon rightfully reflects this and strengthens the theory that the canon is utilized more frequently in dry months.

The most relevant information for evaluation purposes would be the comparison of consumption and rainfall figures for the months of January and March due to the reported weather being similar in terms of rainfall, and the chemical used to be distinctly the old in January and the new in March.

Based on the comparison between January and March at the Mine, with a reported production figure of 1,088,921 tons, the actual saving amounts to 18% (or 1,154,255L of water).

The comparison and analysis of the available early data indicate that it is possible to reduce the water consumption without negatively impacting the overall effectiveness of the suppression effort.

The reported combined March throughput at the Mine was 3,219,041 tons. If the chemical was used at these installations and we assume the reduction to be ½ L/ton, the theoretical saving could have been in excess of 1,6ML. If the saving at the Mine can be considered to be a reflection of total possible reduction, 3,412,218L of water could have been saved.

Additional benefits

Apart from the reduction of a scarce resource, the initiative would further save on electricity due to reduced pump application at source and thereby also extending the life of equipment.

Roll-out to other areas

In order to expand the testing to other areas, Benmarc will require the full support of the mine.

Purpose:

1. Determine by actual field testing the moisture addition required to maintain acceptable dust control of ore during the material handling process with newly formulated BM515E.
2. Economic analysis of reduction of water, electrical, and maintenance costs utilizing BM515E.

Responsibilities:

The Mine:

1. Contractual support by purchase of chemical, maintenance, and replacement parts to assure reliable operation of the Dust Suppression System (DDS). This may include purchase of additional spray nozzles and other components.
2. Proper support, and designation of the Mine point person.
3. Testing of product at all locations presently installed and operating.
4. Access to data:
    a. Tonnages per hour, and total.
    b. Hours of operation.
    c. Lab analysis of surface moisture of ore with accurate date taken.
    d. Dust levels taken at strategic locations by the Mine.
5. Access of all of sites required for the project.
6. Modification of systems and PLC software.

Benmarc Environmental:

1. Proper maintenance of the systems, and chemical supply.
2. Manpower to implement Test Protocol.
3. Dust monitoring equipment.
4. EZ moisture analyzer.
5. Daily report.
6. Monthly report.
7. Final report.

Test Protocol:

1. Locations to be identified in order of testing.
2. Data to be recorded.
    a. Number of spray nozzles, and sizing.
    b. Solution pressure at the inlet of the manifolds.
    c. Pictures of the above.
    d. Dust measurements during conveying operation (3X per day).
    e. Moisture measurements with EZ moisture analyzer to be taken just prior to each dust measurement test (3X per day).
    f. Lab analysis of ore grade, and surface moisture to be collected within 3 days of sampling. Needs to coincide closely (within reason) of dust level testing.
    g. Picture, and video to be taken during dust level testing.
    h. Notes of any handling, or operational issues to be taken.
    i. Weather data to be tracked.