INSTITUTE OF QUARRYING

NEW TECHNOLOGY IN SCREENING - A PRODUCERS PERSPECTIVE

By

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"New technology in screening – a producers' perspective"

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Gert Coffee has a B.Sc. and a B.Eng (Mechanical) from the University of Stellenbosch, specializing in Industrial Engineering. He is also a registered Professional Engineer with ECSA.

He started working as an assistant Engineer at the Roads Department in Bloemfontein in the Construction machinery department. After working in the Industrial Engineering Department of Lyttelton Engineering Works and hiring out equipment at a company in Honeydew, he again ended up in Bloemfontein in 1982, working as plant manager for a Civil Engineering construction company.

This was where he was first exposed to crushers. Not knowing better they completed a crushing contract utilizing an old Double toggle Jaw and a Style A gyratory crusher, imported into SA in the 1930's.

In 1984 he joined the Raubex Construction group. He has been Managing Director of Raumix, a subsidiary company of Raubex that specializes in mobile and commercial crushing, since 1992.

Since 1984 he has been involved in eight commercial quarries, two commercial Ready Mixed Concrete plants, three mobile Ready Mixed Concrete plants and in crushing millions of tons of aggregate with mobile contract crushing units.

INTRODUCTION

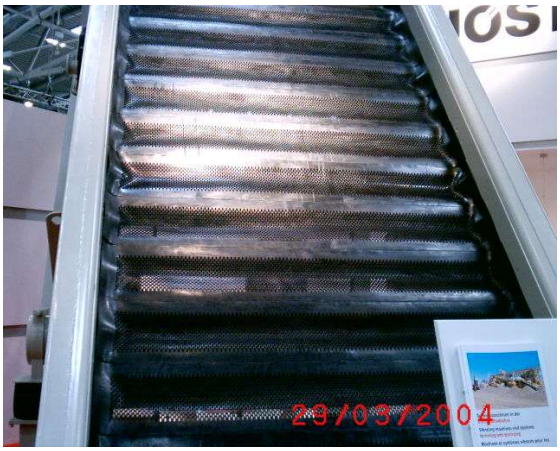
I am convinced that we, the producers, have fallen victim to our own inefficiencies. The manufacturers of screens saw the opportunity and are now selling efficient screening units at a premium to the producers.

We are all screening inefficient. I can make that statement because I know that very few of us get into the screening tower to combat the dust and noise to see what is happening up there.

- **The points to be discussed will be as follows:**
  - Introduction
  - Understanding the basics
  - New developments in screens
  - Basic theory
  - Are we screening effectively
  - What the producer can expect
  - Summary

- **Introduction**
  - While attending the Bauma industrial show in Germany in 2004 I noticed from the exhibitions of the more than 40 suppliers of crushing and screening equipment that the most obvious changes are to screening units and screen cloth.

  - The screens are more compact, especially when used in conjunction with mobile crushing units.
  - New concepts in screen cloths were also to be seen at various stands.



- Responding to a question as to how they manage to use such small screens for such big tonnages one of the suppliers answered that they are now "throwing the G's" at it.

➢ **Understanding the basics:**

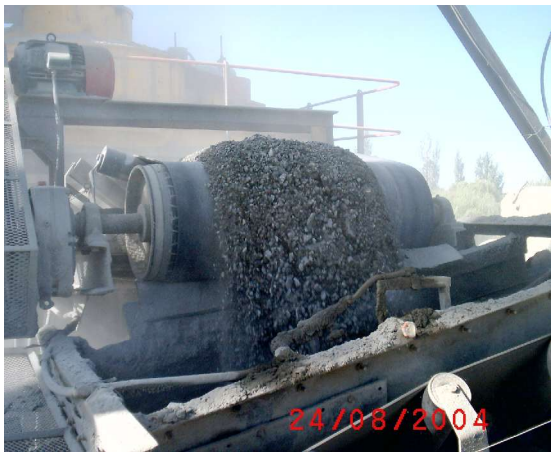
In order to understand why screens are changing it is necessary to understand the basic function of a screen.

- The purpose of a screen: It is to split the material into different sizes while being conveyed.

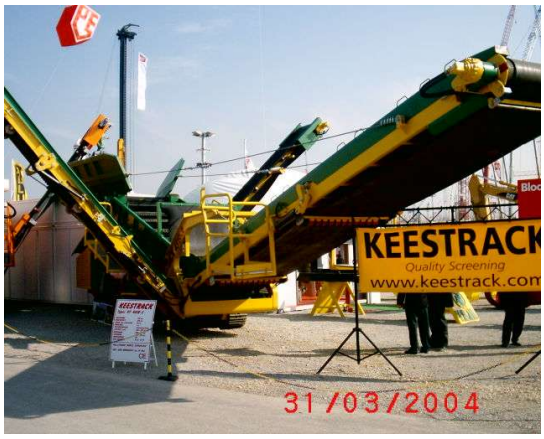
- Screening is an art and not a science: That means that we cannot describe the behaviour of material on a screen in a set of mathematical equations, but in conjunction a lot of experience and knowledge is needed to anticipate the behaviour of the material on the screen.

- Screening rate:

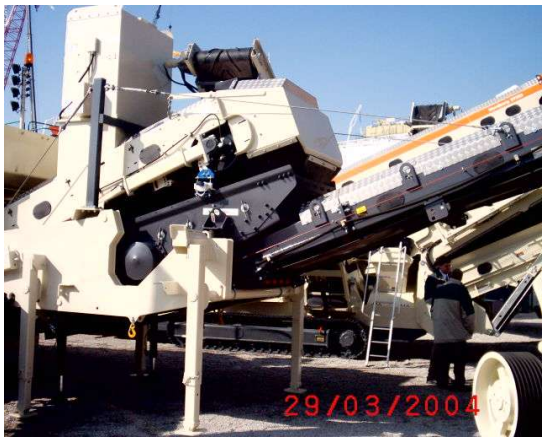
- It is not uncommon in a close circuit crushing set-up that 500 tph of material will report to a screen.
- That is 138 kg of material per second.
- The material move along the screen at a rate of 30 cm per second, which means that on a 6 X 16 screen the material will take 16 seconds to get to the bottom.
    - On a triple-deck screen some of the material will pass over sections of al three screens within that 16 seconds.
    - And we expect to achieve 90% efficiency.
- To put all this into perspective we must think of a 1kg sample that we ask the lab assistant to do a quick 4-way dry split. The results should be available in approximately 45 minutes.
- Therefore the material reporting to the screen in one second will take the poor lab assistant more than 7 days to split.

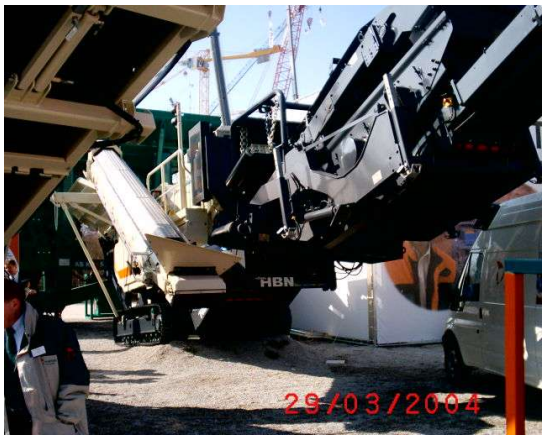


- **New developments in screens.**
  - The most obvious change that we as the user of screens will see is that they will become more compact and still be able to split the same tonnages as the bigger units that we are used to.
  - But why would we want smaller screens? We live in Africa where we have space in abundance and the sky is the limit. It is true, but with the popularity of the mobile crushing and screening units ever increasing, the demand for lightweight and road legal units, preferably with fold-up conveyors at the side thus limiting the size of the screen itself has developed.



  - It was then realised that a mobile screen means additional loads every time the mobile crushing plant is relocated. The suppliers introduced the compact screening unit fitted onto the same frame as the crusher.





- Not only are splitter screens fitted onto the crusher units. As can be seen in the picture on the right multi-decked screens are also fitted.

- The other reasons for screens to develop further are:
  - The specifications are getting more stringent. An example is the road building specifications for the ultra thin frictional courses that demand a flakiness of less than 15%.
  - With natural sand becoming scarce the demand for crushed sand is increasing. In an attempt to prevent blinding new screen cloth is being developed.

➢ **The theory: A short summary.**

It is essential that we understand the basic theory of screens in order to know in what areas it was possible for the manufacturers to introduce developments inscreens.

We shall briefly look at some of the aspects that make up the theory of screens.

- Efficiency:
  - That is the ability of the screen to separate material. In other words if a 100 tph of a certain size report to the screen and 90 tph is screened out the efficiency of the screening process will be 90%.
  - An efficiency of 90% to 95% is achievable.

- Stratification:
  - That is the process where the large particles rise to the top of the bed of material being vibrated. In the picture on the left it can be seen how the bigger particles seems to "rise to the top", as the smaller particles work their way to the bottom to be screened out. It is clear from the picture on the right that stratification is not successful and the screening efficiency will be very low.

- Near size material:

- These are the particles that are ¾ to 1.5 times the aperture size. They form a very significant part of the screen design. These particles are difficult to screen out and need to be exposed to a fairly long screen area to be accepted or rejected through the apertures.

- Incline:
  - The optimal angle of incline is between 12 ° and 30°.
  - In an attempt to increase efficiency some producers will decrease the angle to retain the material longer on the screen. That is not necessarily successful as the bed thickness will increase and preventing the material get to the apertures.
  - The opposite is also true.

- Frequency
  - The frequency is the speed at which the screen vibrates. This vibration will open the bed of material, and assist in the stratification of the material.

- Stroke.
  - The stroke is the throw of the screen and is primarily responsible for moving the material along the screen
  - We will typically use a high frequency and small stroke for fine material and lower frequency and larger stroke for coarser material.
  - On multi-decked screens where we screen coarse and fine material we need to find a happy medium to both sizes. We will however sacrifice efficiency.

- G-force
  - G-force is the acceleration force needed to move the load.
  - Usually 4 to 4,5 G is the maximum acceleration force in a screen.
  - From the equation of G-force it can be seen that the same force can be generated by having to run the screen at high frequency and small stroke, or low frequency and larger stroke. Only through experimenting and experience will you be able to optimise the screening.

➢ **Are we screening effectively?**

Here are some examples of what is happening out there in crushing plants:

- Dead box

- In the picture on the left the material is fed onto the screen without a dead box. At least 10% of the screen is wasted. The 6 X 16 screen effectively becomes a 6 X 14.5. The screen on the right is designed with a proper dead box and will be more efficient.

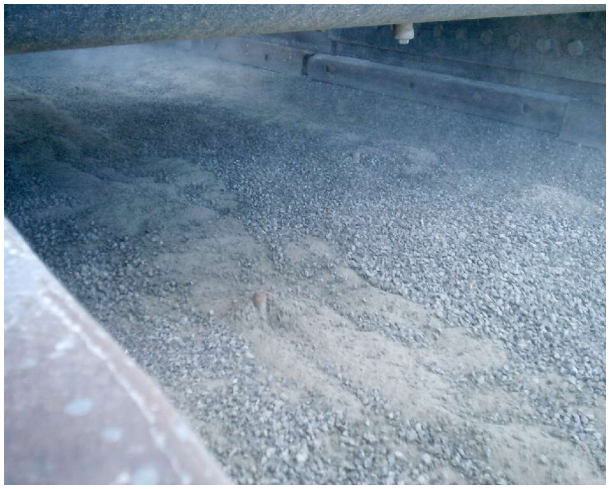
- Stratification
  - In the picture below one can see that the material at the back of the screen is not equally spread. The bed of material on the right hand side is deeper with the result that efficiency will sacrifice.

- In the pictures below it is clear that the material on the top deck is well stratified. On the same screen however it is clear that the material on the bottom deck is bouncing and screening is very ineffective.

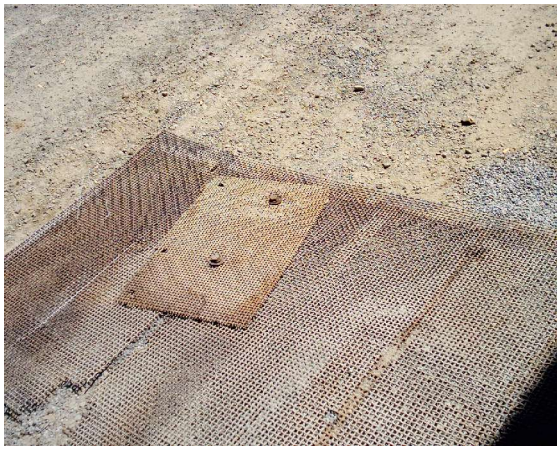
- Top deck

Bottom deck

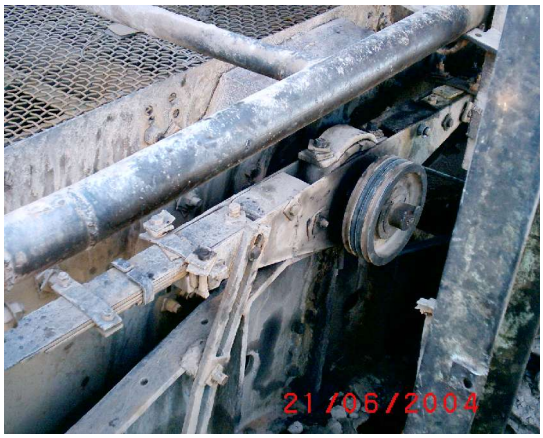
- Blinding
  - The pictures speak for themselves.



- Screen patches
  - Patches may look attractive to save a few cents on the budget, but through the decrease in screening capacity many Rands are lost.

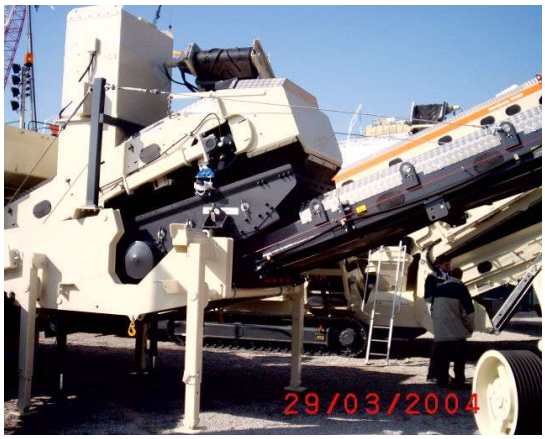


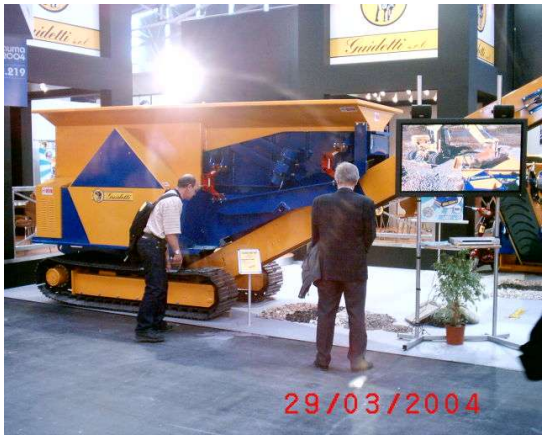
- Suspension
  - The suspension is an integral part of the screen and should be left as it was designed.



- Open area ratio of the screen cloth.
  - A lot of screening area is lost through wrong skirting, wrong diameter screen wire and fasteners.

- **What the producer can expect.**
  - The manufacturers have build screening units that optimised all facets of screening
  - They increased overall efficiency to such an extend that they can produce more compact units.





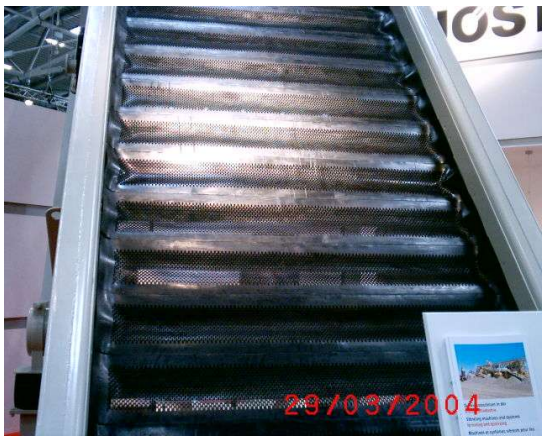
  - The producer shall be introduced to different shapes of screens I.e. the banana-shaped screen and the modular units. The purpose of that will be to speed up the stratification process in the first part of the screen and optimise the crushing of the near size particles in the second section.

- Materials
  - Screen frame material will have to withstand more G-force.

- Bearings
  - More stringent specifications.

- Lubrication
  - Withstand more extreme pressures.

- Screen cloth
  - It seems that the current development of screen cloth is to make it flexible in order to create a "live" screen and prevent blinding.



- Product split
  - More accurate and efficient.

- Motion
  - Specialised motion for the application. Circular, linear or elliptical.

- Suspension
  - Will be optimised for the application.

- Cost
  - Capital cost will be higher.

- Maintenance
  - Maintenance and repair costs higher.

- Environmental
  - More environmentally friendly with less noise and dust.

- **Summary.**
  - There is no new magic in screening.
  - Think before you buy
  - Thorough study of application before you buy
  - The cheapest may not be the best buy for the application.
  - Purposely designed.
  - Get experts involved.