

## CAREFUL CRUSHING OF RECLAIMED ASPHALT ACCORDING TO TL AG-STB 06 (GERMANY) (TECHNICAL DELIVERY CONDITIONS, ASPHALT GRANULATE)

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### ABSTRACT

*The use of Asphalt Recycling is not only subject to economic constraints but also to the statutory provisions for waste management in order to save our valuable resources. These targets are focused in many publications, and primarily manifested in the technical delivery conditions directives for granulated asphalt (TL AG).*

*The challenge:*

*To develop a process that avoids the fragmentation of the aggregate within the reclaimed asphalt and limit the generation of fine material.*

*Principle of Operation:*

*The primary crusher of the granulator is fed with Asphalt blocks up to 1,800 mm in length.*

*Hydraulically powered arms press the material onto the single rotating grinding rotor; where the cutting teeth engages with the material.*

*The speed of the shaft is controlled electronically and ensures a consistent feed of material regardless of its type. The material is pre-crushed to around 0/60 mm, is transferred onto a high-capacity vibrating screen which sizes the finished product.*

*The oversize from the screen is recrushed in the twin shaft BZG 1200 rotor crusher. A space-saving recirculation of the recrushed material to the high-capacity screen ensures that the finished product only contains the required size.*

*The effects:*

*The material is handled gently so that the original grain structure of the aggregates is not destroyed during processing of the asphalt.*

*The granulator produces a significantly larger proportion of 16-22 mm material. Almost 45 %. With regard to the particle size distribution, almost 100 % of RC granulate can be integrated. The Benninghoven Granulator ensures that!*

**Keywords:** Asphalt Recycling, Asphalt Plant, high energy input, low crushing operation cost, 100 % of RC granulate

# Careful crushing of reclaimed asphalt According to TL AG-StB 06 (Germany) (technical delivery conditions, asphalt granulate)

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## 1. Introduction

What do we have to present today? An unusual crushing system?

For crushing purposes, several systems are available:

- Hammermill
- Impact mill
- Jaw crusher
- Cone crusher
- etc ...

Which material has to be crushed?

- Limestone
- Basalt
- Concrete
- other hard rock

... but what about Recycling Asphalt ???

## 2. The solution is ...

...a new developed Recycling GRANULATOR

for carefully granulate all kind of RAP including millings, lumps and slabs

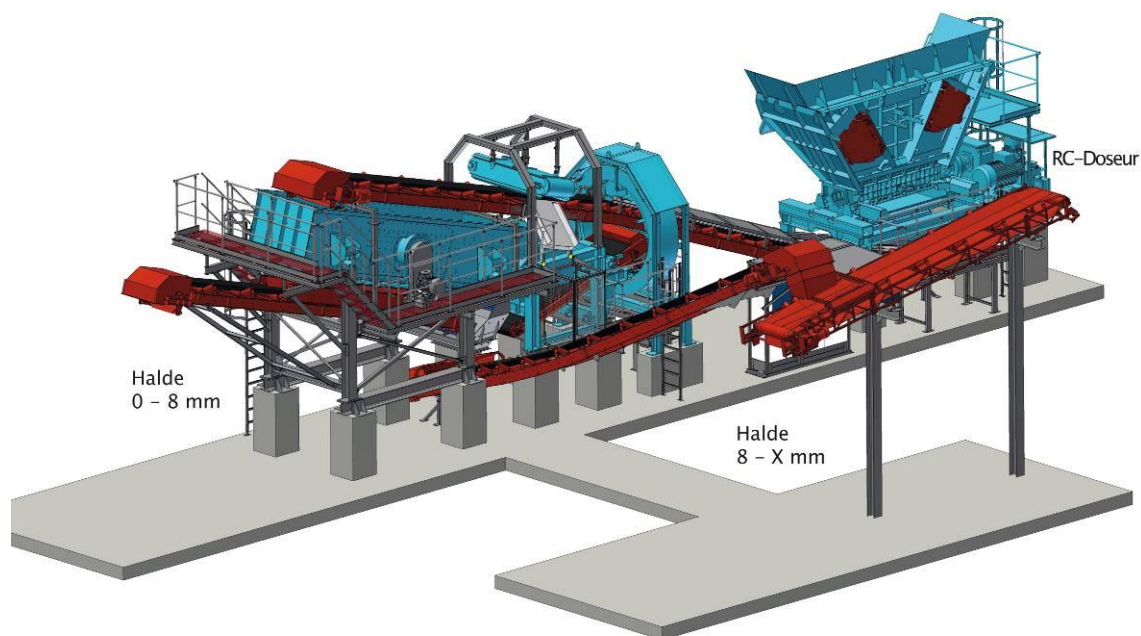


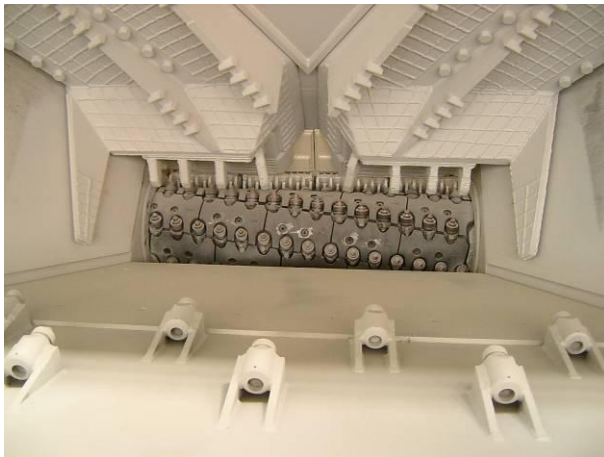
Figure 1: layoutplan Granulator

Primary Granulator / Magnet / Screendeck / Secondary Granulator.

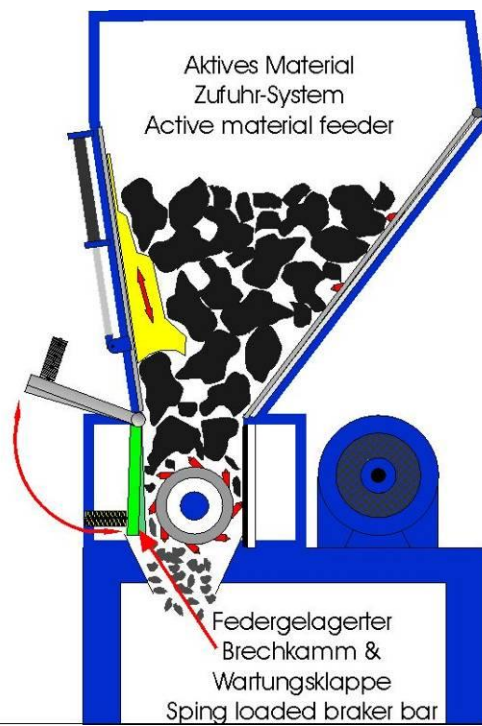
(Available with oversize recirculation if required)

## 3. Primary Granulator BRG2000:

System Components:



**Figure 2: BRG2000 feed bin and granulator shaft**



**Figure 3: Active material feeding system**



**Figure 4: Steel parts, passed the primary Granulator without any damage to the machine**

Characteristic (BRG2000):

Product Range 0-60mm:

- No bridging in feed bin
- Spring loaded breaker plate
  - prevents damage from steel parts
- Short time material contact
  - less wearing, less fines, no dust, does not reduce the particle size
- Direct feed by front-end loader
  - Large asphalt slabs, edge size up to 2000mm (BRG2000)
- Operates at any weather condition
- Granulating millings and/or slabs to required size

The granulating drum capacity is automatically controlled to feed the other plant components at max. production capacity and prevent them from over load.

#### 4. Secondary Granulator BZG1200



Figure 5:

Characteristic of the Secondary Granulator BZG1200:

- Pre screening,
  - large capacity and low wear
- Adjustable and spring loaded granulating drum,
  - limits the final particle size
  - short time material contact
  - No aggregate crushing
  - no problems with steel (springloaded drum)
- uncomplicated system
  - 2 granulating drums with wearing protection,
  - 2 geared motors

#### 5. Available in...

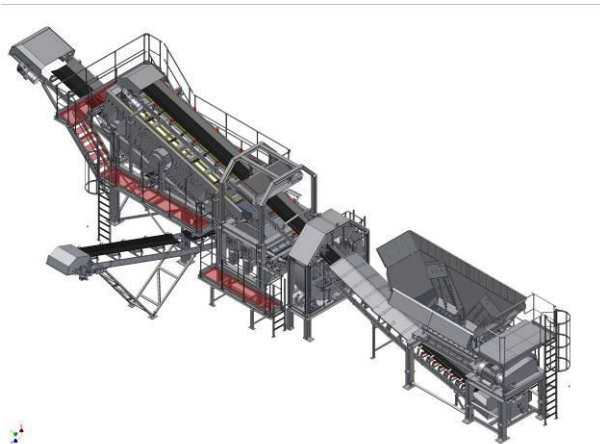


Figure 6: stationary version

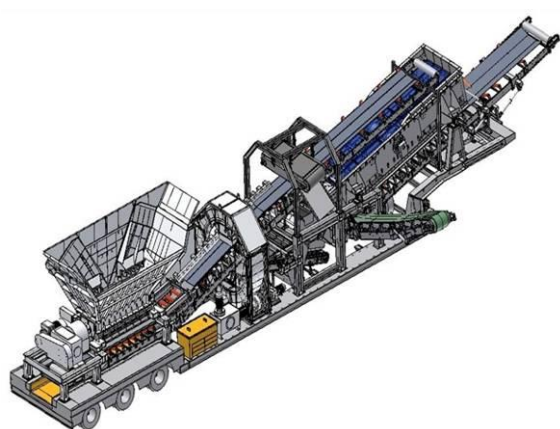


Figure 7: and mobile version



## 6. Most important advantage of this granulating system:

Perfect product gradation for asphalt recycling!!!

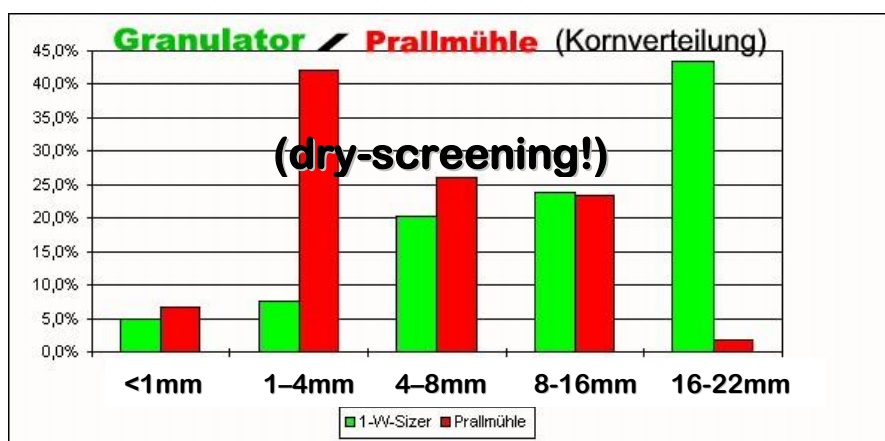
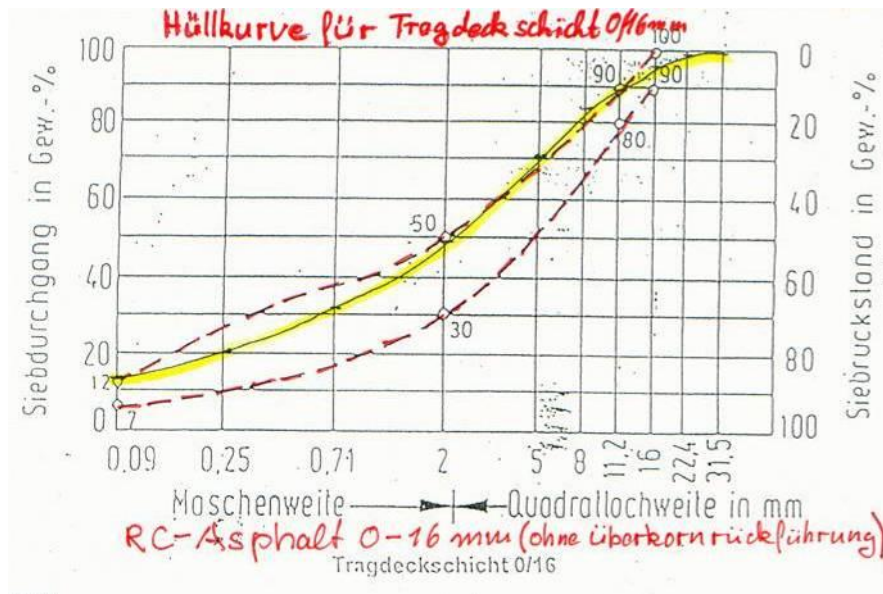


Figure 8: Comparison between an impact Crusher versus (Benninghoven) Granulator.

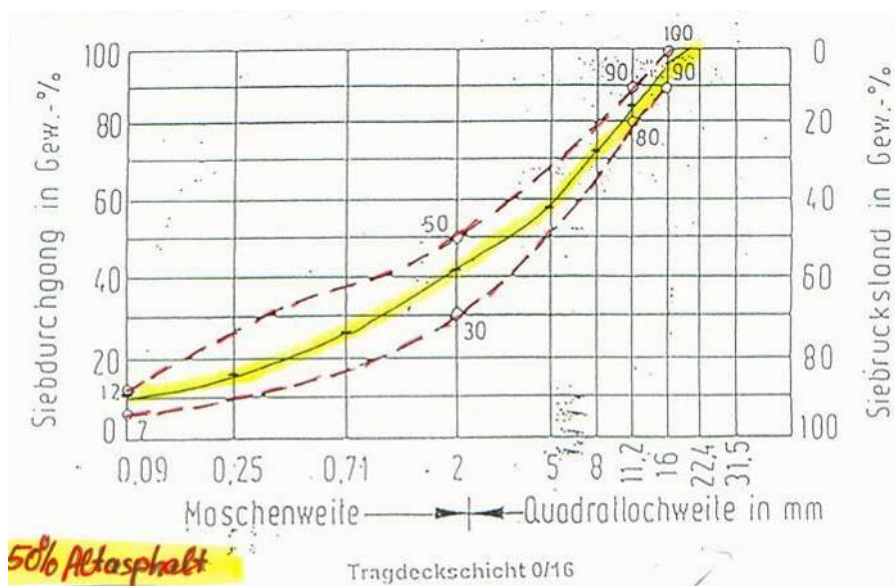




Red line = Limits for a new asphalt mix 0-16 mm

Yellow line = 100% recycling Asphalt; gradation 0-16mm crushed with our Granulators

Figure 9: Grading curve of RC Asphalt, in comparison to the limit value of virgin Asphalt, which is to be produced



Red line = Limits for a new asphalt mix 0-16 mm

Yellow line = 50:50 recycling Asphalt + 50% virgin Asphalt; gradation 0-16mm, crushed with our Granulators

Figure 10: Grading curve of the final asphalt product with 50% RC component

## Prüfbericht

## Auftraggeber

**Tobega AG**  
Eggbühlstrasse 36  
8050 Zürich

A-Nr. 0128-11-KA\_9-07.2011

Probe-Nr. 10819

Baustelle\* Recycling Kontrolle ARGE Nero 2011 Tobega

Unternehmer\*

Probeneingang

26.07.2011

Probe Lage\*

Probe 1  
ab Haufen

Probenahme durch: \*

Sven Seufert

Mischgutsorte: \*

RC G 0/22.4 A ARGE Nero  
Tobega

Entnahme Datum/Zeit: \*

26.07.2011 14:50

Mischwerk: \*

Tobega AG

Entnahmeort: \*

Depot Hard

RC - Anteil in %: \*

100.0

Lieferschein: \*

°C

Bindemittel

Extraktionsverfahren: Manuell

Art / Sorte: \* S 70

löslicher Anteil

3.57

Masse-%

\* Angaben Dritter

Zusätze: \*

SN EN 12697-1/933-1

2.3

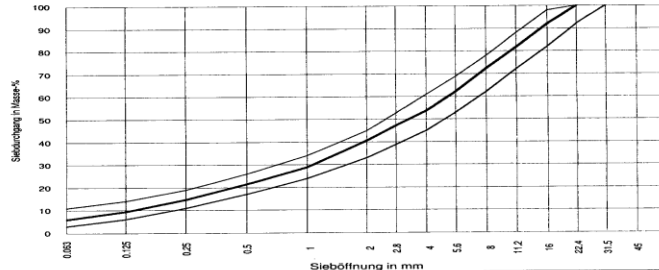
Extraktionsverfahren: Manuell

## Korngrößenverteilung

Sieblinie SN EN 933-1/12697-2

Sollwertbereich SN 640 431-1NA-5NA-7NA

| Prüfsieb [mm] | Durchgang [Masse-%] |
|---------------|---------------------|
| 31.5          | 100.0               |
| 22.4          | 91.9                |
| 16.0          | 81.6                |
| 11.2          | 72.4                |
| 8.0           | 62.2                |
| 5.6           | 53.7                |
| 4.0           | 47.2                |
| 2.8           | 40.5                |
| 2.0           | 28.9                |
| 1.0           | 21.5                |
| 0.5           | 14.6                |
| 0.25          | 9.5                 |
| 0.125         | 5.9                 |
| 0.063         | 5.9                 |



## Marshall - Versuch

EN 12697-6/-8/-30/-34

Dichte Bindemittel:

1.030 g/cm³

Einstampftemperatur:

°C

Raumdicke:

g/cm³

Dichte Mineral:

2.695 g/cm³

EN 12697-6 / Verfahren B-SSD

Stabilität S:

kN

Rohdicke:

g/cm³

EN 12697-34

Fließwert Ft:

mm

EN 12697-5

1) = Verfahren A, Toluol, 25° 2) = Verfahren C berechnet

EN 12697-34

Fließwert F:

mm

Hohlraumgehalt VM:

Vol-%

EN 12697-34

Hohlraumgehalt Mineral-

%

VM - Füllungsgrad VFB:

%

EN 12697-6

SN EN 12697-6

## Eigenschaften des rückgewonnenen Bindemittels

SN 670 403a-NA, autom. Verfahren

Erweichungspunkt R. u. K.

°C

Penetrationsindex PI

EN 12591

EN 1427

Penetration bei 25 °C

10-1

elast. Rückstellung

%

EN 1426

EN 13398

Ausziehlänge:

Bemerkungen:

Prüfdatum / Unterschrift Viatec AG

Peter Bodmer

27.07.2011

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**Figure 11: Grading curve of Recycling Asphalt, (asphalt lumps to 0-22mm) granulated by Granulator MBRG2000**

| Screen-Mesh<br>in mm | Throughput<br>in % | Single-<br>fraction in % |                 | Groups<br>Shares in % |                   |
|----------------------|--------------------|--------------------------|-----------------|-----------------------|-------------------|
| 31,5                 |                    | 0,0                      | > 22,4          | 0,0                   | Oversize          |
| 22,4                 | 100                | 8,1                      | 16 bis 22,4     |                       |                   |
| 16,0                 | 91,9               | 10,1                     | 11,2 bis 16,0   |                       | Grain >16 = 8,1%  |
| 11,2                 | 81,8               | 9,4                      | 8,0 bis 11,2    |                       | Grain >11 = 18,2% |
| 8,0                  | 72,4               | 10,2                     | 5,6 bis 8,0     |                       |                   |
| 5,6                  | 62,2               | 8,5                      | 4,0 bis 5,6     |                       |                   |
| 4,0                  | 53,7               | 6,5                      | 2,8 bis 4,0     |                       |                   |
| 2,8                  | 47,2               | 6,7                      | 2,0 bis 2,8     | 52,8                  | Grain > 2,0       |
| 2,0                  | 40,5               | 11,6                     | 1,0 bis 2,0     |                       |                   |
| 1,0                  | 28,9               | 7,4                      | 0,5 bis 1,0     |                       |                   |
| 0,5                  | 21,5               | 6,9                      | 0,25 bis 0,5    |                       |                   |
| 0,25                 | 14,6               | 5,1                      | 0,125 bis 0,25  |                       |                   |
| 0,125                | 9,5                | 3,6                      | 0,063 bis 0,125 | 41,3                  | Sand 0,063 to 2,0 |
| 0,063                | 5,9                | 5,9                      | 0 bis 0,063     | 5,9                   | Filler to 0,063   |
|                      |                    | 100                      |                 | 100                   |                   |

**Figure 12: Summary of grading curve above (Figure 11)**

## 7. Benefits of this granulating system

Products variable from 0-8mm to 0-60mm; capacity up to 250t/h

- High throughput
- Short time material contact
- Less fines, less dust
  - material absorbs less moisture = lower heating cost!!!
  - does not stick at feeding devices and RAP heating systems
- High protection against damage from steel parts
- Low labor costs (one man operation)
- Low wearing cost (less than 25 Euro Cent / t (German asphalt))
- Low energy cost (less than 11 Euro Cent / t (Germany))
- Careful crushing,
  - does not reduce the original particle size and change gradation
  - important to realize high RAP percentage.

## 8. The concept of Benninghoven

Development of a special product

- There are many normal crushing systems;  
we are granulating the material very carefully
- always looking for a solution  
and never give up!
- Realization of solutions;  
and always looking forward, because ...

... who stops swimming against the river  
floats backward! ☺  
(Chinese proverb)

Thank you for your attention !!!

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