

# Recycling at the highest level - today solutions for the standards of tomorrow

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## ABSTRACT

*The Asphalt Industry constantly searches for new solutions in order to optimise processes within the Asphalt Plant. A major subject is the increase of RAP content in all recipes. Recycling Parallel Drum Systems work in various sizes and at various power levels. This technique has been established by different producers over the decades. However, all kinds of concepts in heating up RAP material in the parallel flow system has its limits.*

*The physical properties of the parallel flow drum system came with some negative characteristics such as high exhaust gas temperatures to reach the RAP material product temperature and high emission levels, which lead us into a new development with our long term partner BAM (Bavarian Asphalt Plant Works) to find a different way forward for this technology.*

*In the mid 1980' the technique of indirectly heating the RAP utilising a hot gas generator was introduced but not perfected, unlike the new system. For Benninghoven's Development Technical Team the biggest challenge was to configure the fan arrangements for recirculation and exhaust conditions based on theoretical values.*

*Based on the calculated theoretical values the system was technically configured. Additional to this some specific specialties were taken into consideration.*

*A real challenge for the Development Team was how to handle the fine particles in the exhaust gas. A simple and ingenious solution was found. The dirt gases first reach a generously sized expansion chamber where the air speed is reduced. The particles then fall into a collection hopper and they are transferred by a screw conveyor into the hot recycling buffer silo.*

*The development teams were astonished that the estimated values were exceeded.*

*During the testing phase the system was closely monitored, emission tests were taken, samples were analysed, recipes created were modified accordingly, and processes were optimised with the result that the plant performed to 100% of the specification.*

*The computer monitor screen shows a filter exhaust gas temperature of 90°C and a recycling product temperature of 172°C. The C Total value had been constantly recorded to be below 50 mg, therefore these values are well below the applicable norm of Germany's "TA-Air".*

**Keywords:** Aggregate, Asphalt, Energy saving, Environment, Reclaimed asphalt pavement (RAP) Recycling

## Recycling at the highest level - today solutions for the standards of tomorrow

The Asphalt Industry constantly searches for new solutions in order to optimize processes within the Asphalt Plant. A major subject is the increase of RAP content in all recipes. Recycling Parallel Drum Systems work in various sizes and at various power levels. This technique has been established by different producers over the decades. However, the various concepts of heating up RAP material in the parallel flow dryer system have their limits.

The physical properties of the parallel flow drum system came with some negative characteristics such as high exhaust gas temperatures to reach the RAP material product temperature and high emission levels, which lead us into a new development with our long term partner BAM (Bavarian Asphalt Plant Works) to find a different way forward for this technology.

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### 2. Requirements for a new RAP-parallel drum system

- higher product temperature
- low exhaust gas temperature, thereby energy saving
- gentle heating of the recycling material
- compliance with the expected new data of the TA-Luft

### 3. Development of a new RAP-parallel drum system

The most important decisions for the development of the new RAP-parallel drum system

- drying of recycling in counterflow
- hot gas generator with high volume flow
- efficient burner
- Ducting systems to optimize the energy efficiency of the hot gases
- separation system to extract fine particles from the volume flow
- efficient control system for the entire process

### 4. Description of mediums and gas flows in the plant type RA220HG

In this slide you can see the flow of the different gases in the RA220HG system.

1. The black coloured flow is the flow of the Recycled asphalt pavement RAP.
2. Yellow is the flow of the hot gas. In this new system the RAP Material will be heated by this 400 to 600°C hot gas. This Temperature is enough to heat the material about 165K without burning the bitumen particle.
3. The red flow is the circulation gas, this gas flows from the exhaust hood that has the function like a skimmer, back to the burner chamber. If there are particle of hydrocarbons the will be burned off in this chamber.
4. The blue line is the gas flow that goes to the filter system and chimney.
5. The green line represents the fine particles skimmed out of the air flow, this fine hot material will be transported to the hot recycled asphalt.

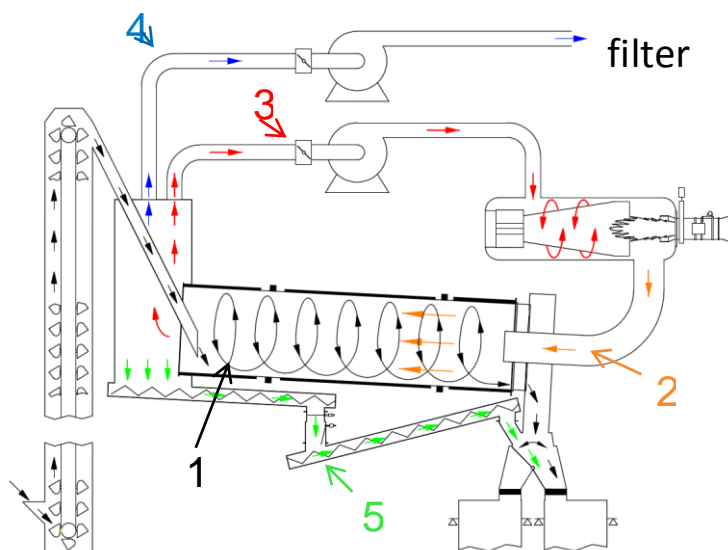


Figure 1: mediums and gas flows in the plant type RA220HG

## 5. Flow sheet of the RAP-parallel drum system type RA220HG

This slide describes in a flow sheet the six parts of the System. Green is the exhaust hood, in this chamber we expand the air flow, and most of the particles in the hot gas fall out down to the chamber bottom. Grey is the RAP Dryer, the recycled asphalt is transported in this counter-flow drum. Yellow is the burner chamber, in this chamber the hot gas will be produced. Red and light grey parts are the air systems which are computer controlled. The exhaust fans blow the process air into the filter system or back into the process.

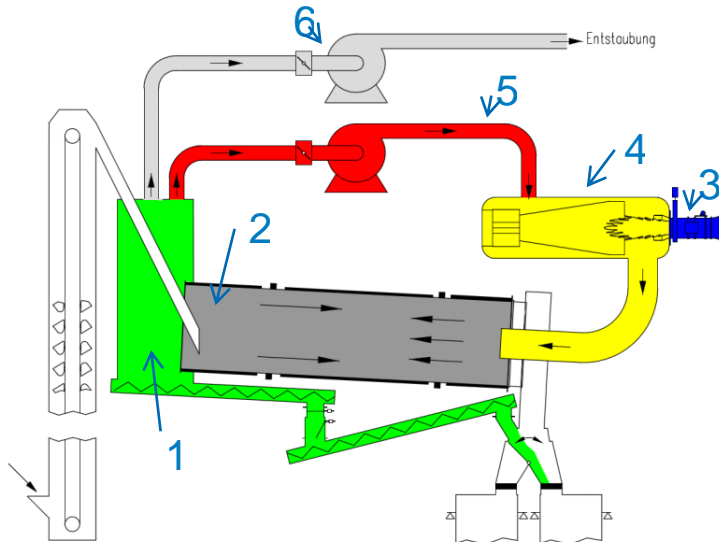


Figure 2: Flow sheet of the RAP-parallel drum system type RA220HG

### 5.1. Exhaust hood with separator system

In this slide you will see that we have to do this effort to separate the overpressure in the hot gas and the under pressure in a plant system. With screw conveyors we transport the separated filler, and take it back to the RAP – flow.

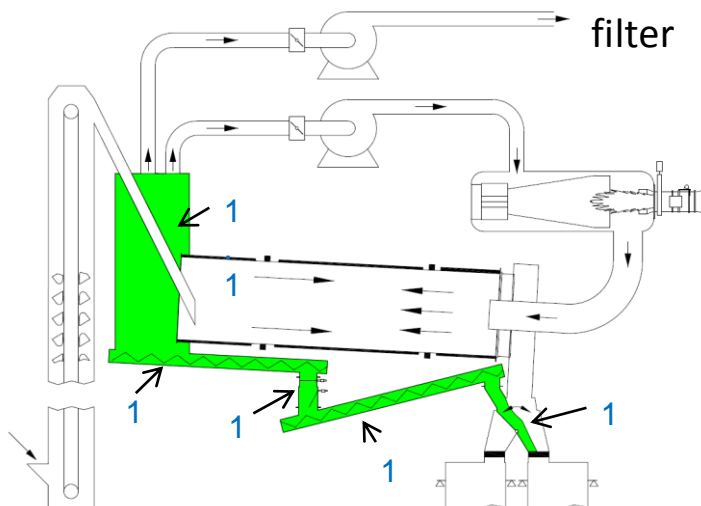
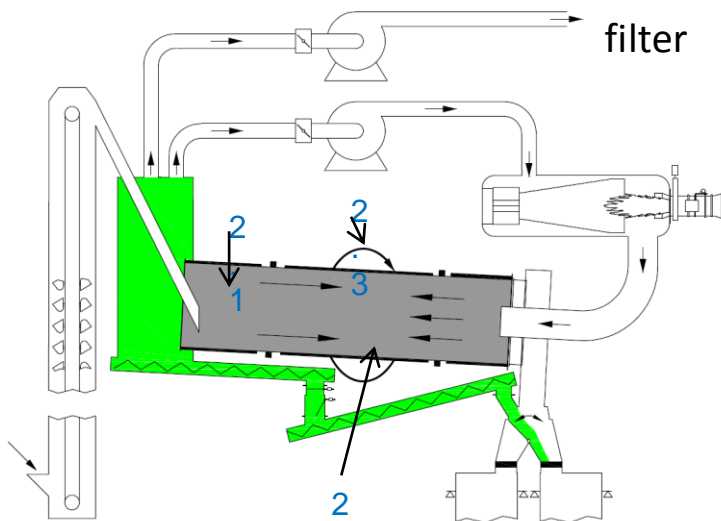


Figure 3: Exhaust hood with separator system

### 5.2. RAP- counter-flow dryer

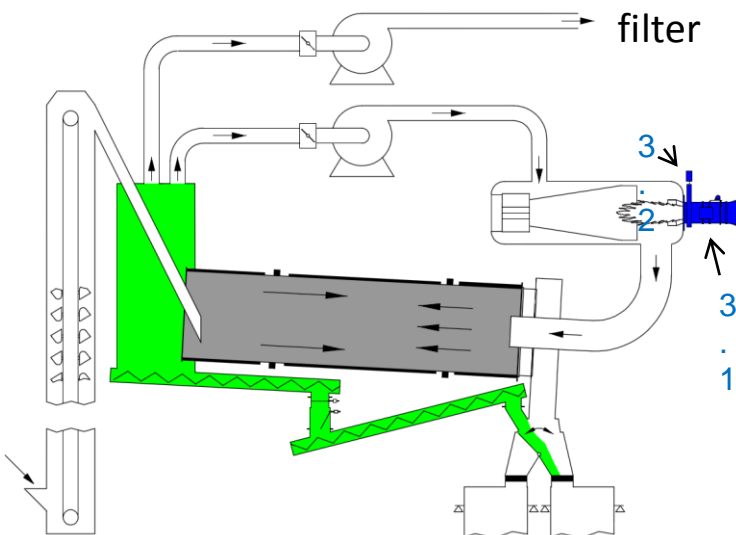
Recycled Asphalt pavement (RAP) is a very sticky material when it is hot. Rotation of the drum and the inclination is very important. In the hot gas system in the counter flow drum, it is possible to heat the RAP up to 175°C



**Figure 4: RAP- counter-flow dryer**

### 5.3. Burner with isolation system

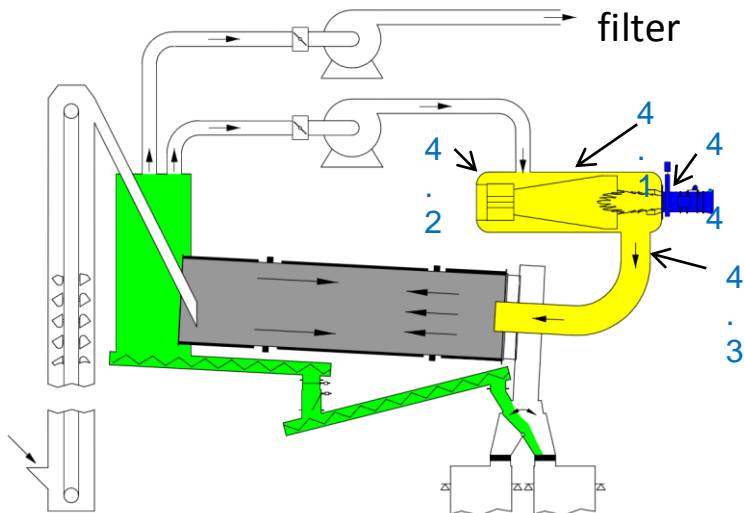
To fulfill the TA Luft the German requirement for Air emissions, the burner position and the gas flow have to be carefully controlled to minimize the emissions.



**Figure 5: Burner with isolation system**

### 5.4. Hot gas generator

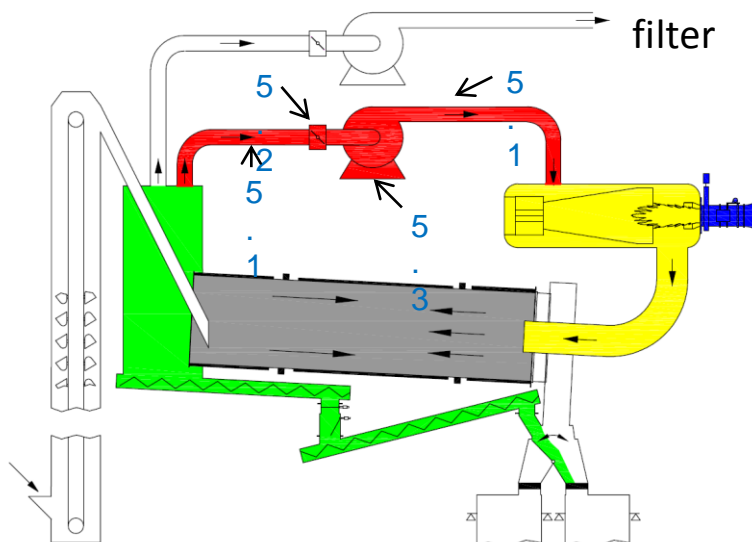
In the Hot gas generator chamber we mix the fresh air for the burning process with the circulating gas which contains hydrocarbons. These hydrocarbons will be re burned off by the heat of the burner flame.



**Figure 6: Hot gas generator**

**5.5. RAP – air circulation system**

Next part of this system is the RAP air circulation. Here a frequency controlled fan blows the air to the hot gas generator.



**Figure 7: RAP – air circulation system**

**5.6. RAP exhaust system**

Dear colleges from the Asphalt industry.

In a normal asphalt mixing plant we have one exhaust fan to provide the under pressure in the whole extraction system. This prevents dust escaping to outside the plant, and controls the burner flame for efficient combustion with low emissions. Here we have another exhaust fan to control air and gas flows to minimize the hydrocarbons being produced in the rap process.

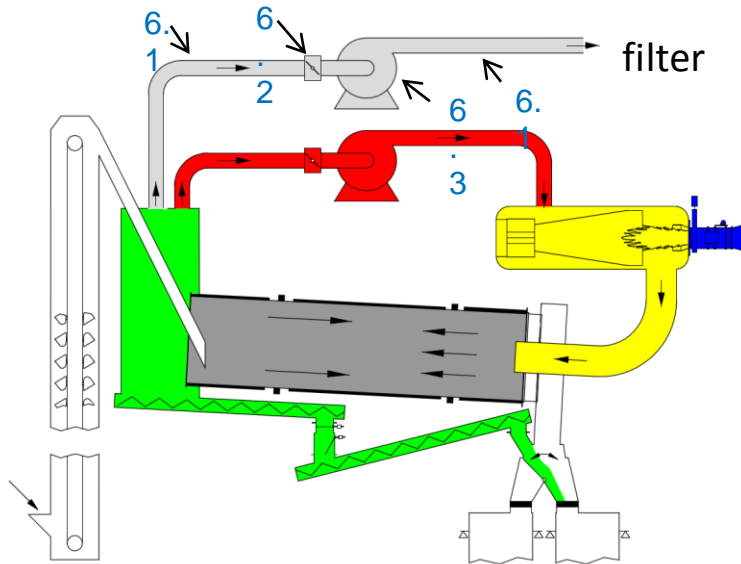


Figure 8: RAP exhaust system

## 6. Most important results of the pilot plant

Table 1: Results of the pilot plant

	RAP-parallel Drum	Hot Gas	Advantage
Mat. Temp.	130 °C	160 °C	+30 K → Asphalt temperature
RAP Addition	70 % Rec.	>90% Rec.	
Mineral	250 °C	→ 160 °C	-90 K → Mineral
Exhaust Gas	150-160 °C	~ 100°C	50-60 K
Result:			
<ul style="list-style-type: none"> <li>- lower energy input</li> <li>- lower environmental stress</li> <li>- higher quantity</li> <li>- minimising operating costs</li> <li>- sustainable</li> </ul>			

## REFERENCES

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