TECHNOLOGICAL PROCESSES OF ACTIVATED MINERAL POWDER FROM SLASINE ROCKS

[1]Sadikov Ibragim Salixovich, [2]Buriyev Shuxrat Xamidovich
[1]Prof. [2]Phd.
[1,2]Tashkent State Transport University
https://doi.org/10.5281/zenodo.11080061

Abstract. *The article presents the technological processes of extracting activated mineral powder from shale rocks using a centrifugal impact mill, and the results of comparison of the activated mineral powder produced in this technological process with the requirements of the normative document.*

Keywords: *centrifugal impact grinding mill, technological processes, fine-grained hot dense asphalt concrete, specific surface area, activated mineral powder from shale rock.*

Today, in the network of highways, small-grained hot dense asphalt concrete is used for one type of pavement. The quality of mineral powders is important in the production of this type of asphalt concrete. Mineral powders have a specific surface during the production process. In the process of grinding shale rocks, mechanically activated mineral powders are obtained by centrifugal impact grinding when a disintegrator mill is used. The production of mineral powder is carried out in several stages. First, it begins with the preparation of the necessary raw materials, i.e. bringing shale rocks from the quarries. Brought shale rocks are dried in special drying drums. If it is of high strength, it is first crushed to 10-20 mm in roller or hammer mills. In some cases, this step is omitted when the shale rock from the quarries is of the desired fineness.

In the production of activated mineral powders produced today, together with rocks, the processes of preparing activators are also carried out. Bitumen and surface-active additives are heated to working temperature. Ground mineral powder is prepared for activation by adding an additive. Dried raw materials and activating additive are taken in the required amount and mixed until a homogeneous mass is formed. Other types of devices can also be used in the mixing process. When the mixture is thoroughly mixed, it is sent to a grinder to obtain mineral powder of the required size. After that, the prepared mineral powder is sent to a storage box or a storage warehouse.

In the process of obtaining activated mineral powder from shale rocks, the above addition process is not used when it is ground in a disintegrator. Disintegrator working process During centrifugal impact operation, shale mineral powders are mechanically activated.

The technological sequence of production of activated mineral powder from shale rocks is carried out as follows (Fig. 1)

1. Excavation of rocks with an excavator
2. Preparation of rocks for loading onto dump trucks in the quarry
3. Loading rocks onto dump trucks
4. Preparation of rocks in the shop
5. Delivery of material through a corridor (iron tape).
6. Grinding rocks in the specified fraction in a shekovoy crusher
7. Transfer of the crushed material in the specified fraction to the mill (melnisa) through a corridor (iron tape) or a conveyor belt

8. Grinding fractional material using a disintegrator mill (turning it into a powder state)

9. Placing crushed material in a special bunker or silo

10. Loading or packaging of the finished product on special equipment (cement truck).

11. Conducting tests to study product quality.

The large-sized material is conveyed to the shekovoy crusher through a conveyor belt (iron belt). The Shekovoy crusher has a regulator (adjuster), and through the regulator, a product of the required size is released. The finished material in the desired size (fraction) is delivered to the rotary mill through a conveyor belt or a corridor (iron belt). The size or fraction of the crushed product is controlled (regulated) using a metal screen. The finished crushed (powdered) product is placed in a warehouse (silo). After passing the laboratory test, the product in the warehouse is packed in large bags or delivered to customers in a special autotransport (vehicles similar to cement trucks).

In winter-autumn-spring seasons, when there is a lot of precipitation, fractional products are dried in special drying drums in the shop, and then the dried product is delivered to the mill for grinding. During the drying process, the temperature of the material should not exceed 180-200°C.

Rules for acceptance of mineral powder from shale rocks

1. The powder must be accepted by the manufacturer's department that carries out technical control.

2. Reception and delivery of powder is carried out in batches.

– When receiving a batch, the amount of powder released per shift in each production line is taken into account, but it should not exceed 200 tons.

– When shipped by truck, a batch is the amount of powder shipped to one customer during the day.

– When shipped by rail, a batch is the amount of powder shipped at one time to one customer on one train.

3. Powder quality control is performed by testing one pooled powder sample from each lot.

4. The combined sample consists of additional samples taken from the supply (collector) hopper or directly from the production line.

Sampling starts 30 minutes after the start of powder release and every hour during the shift. Depending on the performance of the technological equipment, the interval of taking additional samples can be increased, and the number of additional samples should be at least four.

5. The additional sample must weigh at least 500 g during the 1-hour sampling interval. As the sampling interval increases, the weight of the selected additional sample should be increased: 2 times at 2-hour intervals, 4 times at 3-hour intervals.

6. Selected additional samples are thoroughly mixed and quartered for laboratory sampling.

For a quarter, a sample of material is flattened and divided into four parts by mutually perpendicular lines passing through the center. Any two opposite sides are sampled.

7. The weight of the laboratory sample for acceptance control should be at least 1 kg, for periodical control - at least 3 kg.

Sample until the above mass is sampled by successive quartering

2nd time, 4th time, etc.

8. During the admission control, the following are determined:

- grain composition;

- humidity;

9. Periodic control is carried out with each change in the composition of the starting materials, but at least once a month. During periodic monitoring, the following are determined:

- porosity;
- number of samples from a mixture of bitumen and powder;

10. For each batch of powder sent to the consumer, the manufacturer is obliged to provide a quality document that shows the following information:

- name of the manufacturer;
- passport number and date of issue;
- name and address of the consumer;
- batch number and amount of powder;
- the name and brand of the powder;
- the name of the raw material used to prepare the powder;
- grain composition;
- humidity;
- porosity;
- number of samples from a mixture of bitumen and powder;
- bitumen strength index;
- water resistance of samples from a mixture of powder and bitumen;
- specific effective activity of natural radionuclides.

According to the results of the research conducted in the territory of our country, 5 different types of shale rocks have been identified. Activated mineral powder obtained from shale rocks in Nurabad district of Samarkand region of the Republic of Uzbekistan was tested in laboratory conditions, and the results were obtained according to GOST 16557-2005 “Порошок минералнйй для асфальтобетоннйх и органоминералнйх смесей” T.U. was compared with the requirements of the normative document and it was determined that it corresponds to the requirements of active mineral powder. The test results are presented in Table 1.

According to the test results, the activated mineral powder obtained from shale rocks meets the requirements for mineral powders used in the production of asphalt-concrete mixes.

In the process of studying the chemical composition of mineral powders, we can see that if the amount of aluminum increases by 20% in the production of asphalt concrete mixtures, it does not bond well with bitumen. For this reason, measurement work was carried out on the amount of aluminum in the mineral powder. When studying the results obtained with the XRD-6100 diffractometer, it was found that the amount of aluminum in activated mineral powder, ozokerite mineral powder and limestone mineral powder obtained from shale rocks is less than 20 percent. This, in turn, ensures the cross-linking of the binder and inert materials in the coating.

The quality and strength of fine-grained hot dense asphalt concrete mixtures are greatly affected by the degree of fineness of mineral powders and the shape of their particles.

Therefore, activated mineral powders obtained from shale rocks, mineral powders obtained from limestone materials and mineral powders obtained from ozokerite material were subjected to microscopic analysis.

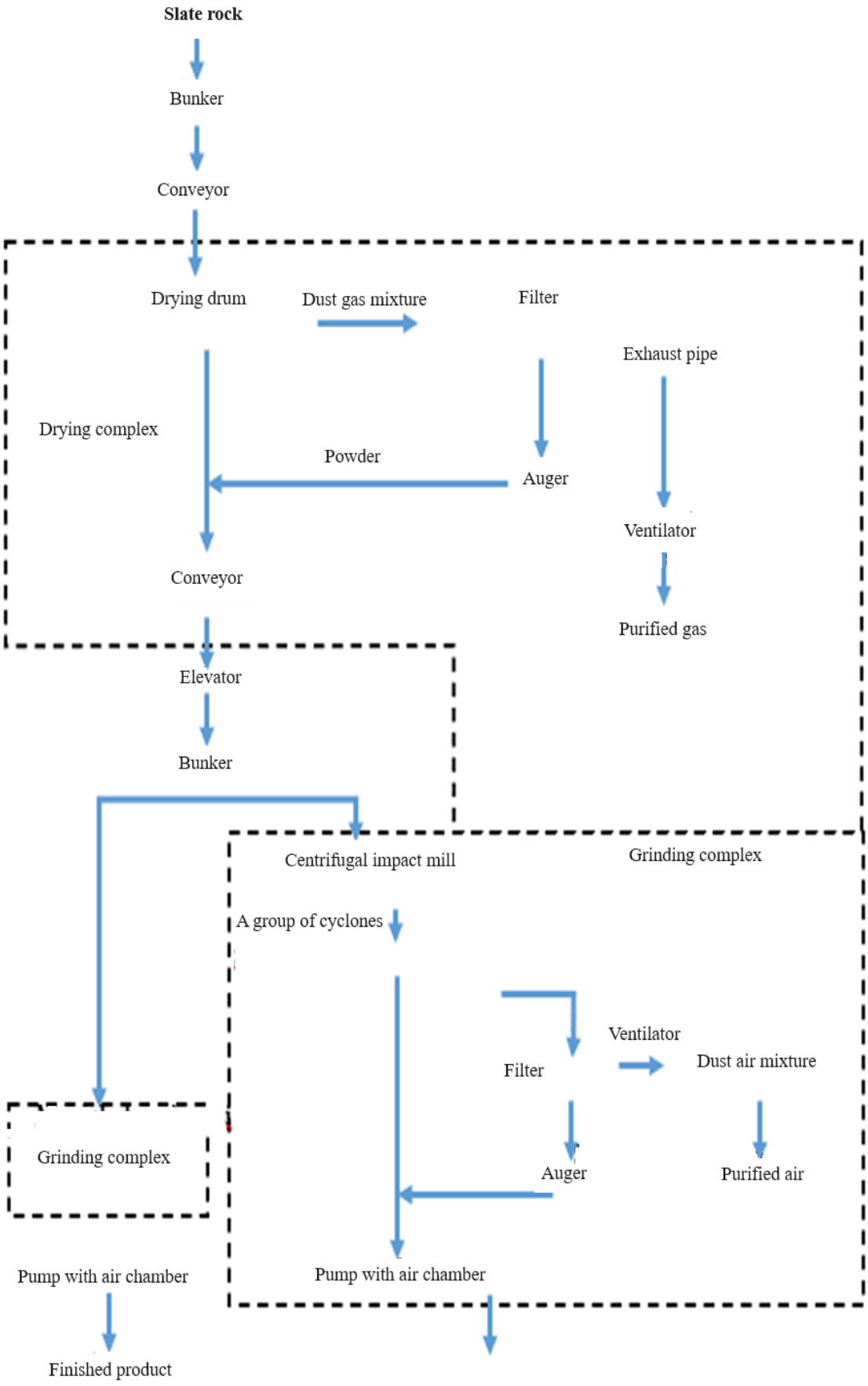

Figure 1. Technological scheme of obtaining activated mineral powder from shale rocks

Table 1

Indicator names	Unit of measurement	Indicator value		
		Standard value	Average value obtained	Regulatory compliance
Natural humidity	%	0-1,0	0,8	-
Grain composition, mm	1,25	at least 100	99,6	**fits**
	0,315	at least 90	91,7	**fits**
	0,071	at least 80	81,2	**fits**
Density	g/cm^3	is not regulated	2,6	-
Porosity, at least	%	30	28,9	**fits**
Reproduction of a sample of a mixture of bitumen with mineral powder		**1,8**	**1,6**	**fits**

Figure 2. MoticVA 210 microscope

In the microscopic analysis, the grain structure of mineral powders, the amount and shape of needle-like and leaf-like particles were studied. We can see the obtained results in Figure 1.

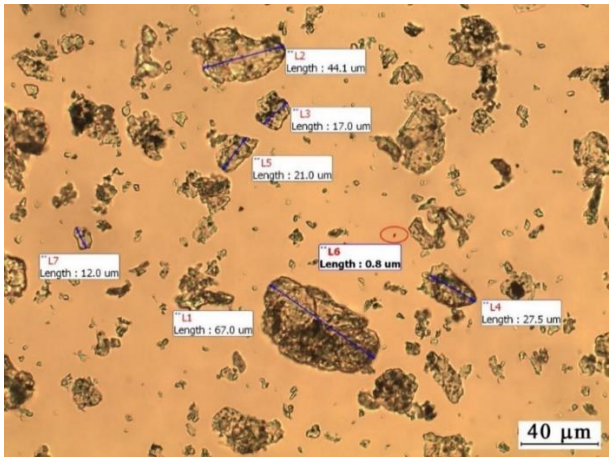

Figure 3. View of particles of activated mineral powder obtained from shale rocks under a Motic VA 210 optical microscope

Optical microscopic analysis of mineral powder obtained from shale rocks revealed that it consists of particles of the following sizes:

L1- 67 microns — 0.9%;
L2- 44.1 microns — 1.78%;
L3- 17.0 microns — 5.35 %;
L4 – 27.5 microns — 3.57 %;
L5 – 21.0 microns — 6.25%;
L6- 5.0 to 0.8 microns — 71.42%;
L7- 12.0 microns — 10.73%.

It was found that 96.35% of this mineral powder is made up of cubic particles, 3.65% of needle-shaped and leaf-shaped particles.

Conclusion: The particle sizes of the activated mineral powder obtained from the slanes rock are in a close sequence. The advantage of this is that the filling between the coarse and fine aggregates in the mixture allows the required portion to be almost completely occupied by this mineral powder.

Activated mineral powder obtained from shale rocks differed from mineral powder obtained from limestone and mineral powder obtained from ozokerite by the cubic shape of its particles and the presence of very small amount of needle-like particles. Based on the world experience and previous scientific work, the amount of cubic particles in the mineral powder affects the bonding of the asphalt concrete mixture with the inert stone material, and as a result, serves to increase the strength. This is achieved by forming a mineral powder+bitumen binder with bitumen of activated mineral powders obtained from shale rocks.

Production of mechanically activated mineral powder from shale rock is carried out in the technological process of production of mechanically activated mineral powder from shale rocks obtained by grinding into powder in a centrifugal hammer mill. Mineral powder produced from shale rocks in a centrifugal impact mill meets the requirements of activated mineral powders.

REFERENCES

1. Al-Sayed, M.H.,"The Effect funeral filler performance of tolled Asphaltic Mixes", Ph.D. Thesis, University of Leeds, 1988.
2. Sodiqov I.S, Sh.Buriyev “Investigation of the effect of shale mineral powder on the physical and mechanical properties of asphalt concrete” Harward educational and scientific Review 2021-35-45 r
3. Sodiqov I.S, Sh.Buriyev “Slanesli mineral kukunlarning asfaltobeton qorishmalari mustaxkamligiga ta’siri” TAYLQEI 2019-y.
4. I.S. Sadiqov, Qoraboyev A.M, SH.X.Buriyev “The effect of the optimal granulation composition of mineral powder from slasine rocks on the increase of the coating strength of asphalt concrete mixtures at high temperatures” jurnal Samarqand.
5. Zhenyang Fan, Xuancang Wang, Zhuo Zhang va Yi Zhang Ministry of Transport of the People’s Republic of China. Technical Specifications for Construction of Highway Asphalt Pavements; Highway Research Institute of China, Transport Ministry: Beijing, China, 2004; Volume A4, p. 196.
6. Wasilewska, M.; Małaszkiewicz, D.; Ignatiuk, N. Evaluation of different mineral filler aggregates for asphalt mixtures. In Proceedings of the IOP Conference Series: Materials

Science and Engineering, Prague, Czech Republic, 12–16 June 2017; IOP Publishing: Bristol, UK, 2017; Volume 245.

7. Modarres, A.; Ramyar, H.; Ayar, P. Effect of cement kiln dust on the low-temperature durability and fatigue life of hot mix asphalt. Cold Reg. Sci. Technol. 2015, 110, 59–66.
8. GOST16557-2005 “Порошок минералнйй для асфалобетоннйх органоминералнйх смесий”
9. Xarris BM va Stuart KD, “Tosh matritsali asfaltda ishlatiladigan mineral kukun moddalari va mastikalar tahlili”, J. Dots. Asfalt yotqizish texnologiyasi. , 1995-yil.
10. Grabowski, W. and Wilanowicz, J. 2011. The specific surface of mineral fillers and their functional properties, 5th International Conference Bituminous Mixtures and Pavements Thessaloniki, Greece, 1–3 June 2011, ISBN 978-960-99922-0-6. pp. 246–255.
11. Mixaylusov Yevgeniy Aleksandrovich “Применение отходов металлургической промышленности в дорожном строителстве лесного комплекса” 2014.
12. GOST 9128-2013 “Смеси асфальтобетонныэ, полимерасфалтобетонныэ, асфальтобетон, полимерасфалтобетон для автомобилных дорог и аеродромов” T.U.