



## Technical documentation

### Sealoflex Color asphalt and Colorfalt V pigments

## **1 General**

This technical submittal has been prepared for the supply of Sealoflex color clear binder and Colorfalt V pigments to produce asphalt pavement with various colors.

## **2 Description of products**

Colored asphalt is composed of 3 components namely mineral aggregates, clear binder and pigments. The components are mixed together in a hot mix asphalt batching plant and compacted as regular (black) asphalt concrete.

The color of the asphalt mixture directly after mixing and compaction will be bright, which will later during use of the pavement become darker. Ultimately the bitumen coating at the top of the aggregates will wear off and the appearance of the surface will resemble the color of the aggregate. For this reason it is recommended to use aggregates with natural or artificial colour that more or like resembles the color which needs to be achieved.

### **2.1 Sealoflex color binder**

The Sealoflex color binder is a produced mixed with a processing plant normally used for polymer modified bitumen. The Sealoflex Color product properties comply with the values indicated in the product datasheet included in Appendix A.

Sealoflex Color is produced in an ISO9001 Certified production plant with a dedicated circuit for production of clear binder. Similar to normal bitumen Sealoflex Color does not impose any additional health and safety hazard other than being a hot liquid. See attached the Material Safety Data Sheet enclosed in Appendix A.

### **2.2 Colorfalt V pigment**

The Colorfalt V pigments come in a pellet form produced by means of an extrusion process. The carrier for the pigment in the pellet is EVA polymer. The advantage of Colorfalt V is easy dosage with no dust formation as well as better color intensity in the colored asphalt. Find enclosed in appendix B the product data sheet of Colorfalt V.

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### 3 Packing

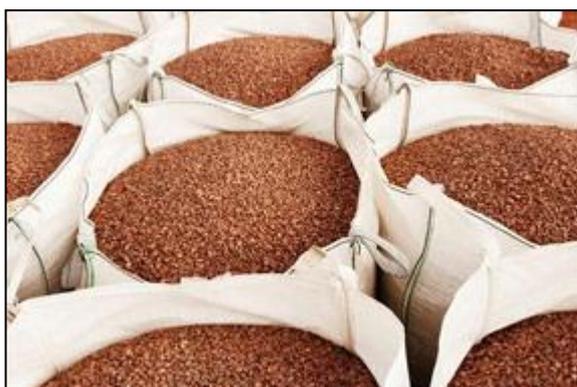
The Sealoflex color binder can be supplied in 20ft ISO bitu containers or in new 200 ltr steel drums. The bitutainers are equipped with a hot oil spiral for heating the material. The hot oil spiral will need to be connected a thermal oil heater.

*Figure 20ft Bitucontainers*



The Colorfalt V pellets are packed in 1 ton big bags or in 20 kg low melt plastic bags and shipped in 20ft seacontainers.

*Figure Colorfalt pigment in big bags*



## 4 Asphalt mix design

Colored asphalt concrete might be dense asphalt concrete for wearing courses or stone mastic asphalt. The asphalt mix design should be performed with representative samples of the aggregates, binder and pigments that will be used in the actual mix production.

It is recommended to use aggregates which resembles the color which needs to be achieved. E.g. for red asphalts red types of granite are available. Otherwise aggregates with a light appearance are preferred but will have to meet the mechanical requirements for the specific type of application. Any case the use of dark coloured baghouse filler must be avoided since it will affect the achieved. Colour. In that case it is advised to use added filler with a light colour only.

Aggregate samples shall be from the stockpile fraction as supplied at the location of asphalt production or preferably from the plant's hot bins. If aggregates from the hot bins are provided then the grading of the stockpiled fractions shall be determined as well to cross check suitability of the mix design. The asphalt mix design can be performed using the Marshall method of mix design with following provisions.

*Table 1 Density of Sealoflex color*

Type	Density kg/m <sup>3</sup> at 25°C	Density kg/m <sup>3</sup> at mixing temperature
Sealoflex Color	approx. 1,010	approx. 900

The recommended mixing and compaction temperatures are as summarized in table 2.

*Table 2 Asphalt mixing and compaction temperatures for Sealoflex<sup>®</sup> Color binder*

Product	Mixing temperature ± 5°C	Compaction temperature ± 5°C	Maximum binder temperature°C
Sealoflex Color	165	155	180

### 4.1 Heating instructions for binder samples:

Below the instructions for heating binder samples in the laboratory are reflected:

1. Place the can containing Sealoflex binder with a loose lid in an oven at approximately 5°C above the mixing temperature given in the Sealoflex table above. Heat until entirely liquid but for no more than 6 hours (use a timer when reheating overnight).
2. Place the hot can on a pre-warmed heating plate (or in an oil bath at approximately 5°C above the recommended mixing temperature).
3. Start mixing and heating the binder to attain the reheating temperature (when using a heating plate avoid local overheating of the binder).
4. Continue mixing for at least 15 minutes.

## 4.2 Mixture composition

The gradation used for colored asphalt is similar to the gradation of normal (black) asphalt. Typically the colored asphalt concrete is made with 8 to 12.5 mm nominal grain size aggregate to reduce the total required layer thickness.

If added filler is used this is preferably be milled limestone or other light coloured filler.

In case of coloured stone mastic asphalt cellulose fibres may be used.

The recommended pigment content is typically 1.5% by weight of the total mixture. It is advised to test mixtures with 1%, 1.5% and 2% of pigments to evaluate the asphalt mix for colorization.

Because of the presence of the EVA carrier in the pellets 20% of the pigment content can be considered as binder in the mixture like indicated below:

Total clear binder	= $B_{tot}$ .
Dosing level of clear binder	= $D_{dos}$
Dosing level of ColorFalt <sup>®</sup>	= $C_f$

Total Bitumen:

$$B_{tot} = D_{dos} + 0,2 C_f$$

Similar to the bitumen content the pigment can be considered as part of the filler of the mixture. The actual filler content (material passing No200 sieve) will be the mineral filler and 0.8 times the dosed amount of pigment.

Total filler content	= $F_{tot}$ .
Dosing level of mineral filler	= $F_{dos}$
Dosing level of ColorFalt <sup>®</sup>	= $C_f$

Total Bitumen:

$$F_{tot} = F_{dos} + 0.8 C_f$$

Sometimes it is hard to extract the binder by means of solvents totally because of the presence of EVA. This is especially the case if the mixture is decomposed by means of extraction at cores which are fully cured. The shortage of bitumen content after extraction may have to be corrected as indicated below. Methylene-chloride is recommend as solvent during extraction.

Recovered binder level  $= D_{rec}$  ( $=D_{dos}$ )

Total Bitumen (recovered):

$$B_{tot} = D_{rec} + 0,2 C_f$$

If the ignition oven is used for determination of the binder content this correction for unrecovered binder is not applicable.

#### 4.3 Mixture procedure for laboratory mixes

After weighing the heated bitumen is put in the laboratory mixing bowl. Subsequently directly hereafter the heated aggregates are added and lastly the Colorfalt pigment is added. The mixture should be mixed for some time in the bowl to make the pellets melt and the mixture is homogenous.

The Marshall mix design for colored asphalt is commonly made with 2x50 blows of compaction effort since this type of asphalt is mainly used for area's with light traffic. However if the mineral aggregate has no soft nature and has good resistance to crushing 2x75 blows might also be used.

*Figure Colored laboratory compacted samples*





The asphalt mix can be designed according the normal Marshall mix design procedures. It is however not recommendable to use the Marshall Stability as design criterion but rather design the mix on volumetric property criteria. This is in particular true for design of colored stone mastic asphalt.

It is recommended to wait 21 days for final colour settlement of your Marshall specimens before select your optimum mix desings.

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## **5 Heating and storage of the binder**

### **5.1 Heating of bitutainer (if applicable)**

The bitutainers are thermal oil heated with a spiral at the bottom of the container and two DN50 outside thermal oil pipeline connection. External (flexible) pipelines to connect the thermal oil heater with the containers are not included in the delivery. It is advisable to keep some thermal oil available to add to the system after connection of the bitutainer.

After connection of the thermal oil heating lines it is recommended to keep the thermal oil initially at a temperature of 180 °C to heat the binder in the bitutainer gradually. Later when the binder becomes completely liquid it is recommended to increase the temperature of the thermal oil to 200 °C to increase the speed of heating. The estimated time for heating the bitutainer is 72 hours. The bitutainer is equipped with an analogue thermometer mounted at the outside shell. The temperature reading shall be monitored and kept in a logbook. The binder shall be heated in the bitutainer until the recommended temperature of mix production is reached.

After the binder is heated to the indicated temperature it can be pumped from the container into the binder tank of the hot mix batching plant by means of an external bitumen pump. The external bitumen pump is not included in the delivery. Before uplifting the clear binder into the production tank of the hot mix batching plant it must be made sure that this tank is as clean as possible and free from foreign material. Connection of the bitu-container directly to the batching plant is also an option.

Since some residual black binder will still be remaining in the bitumen pipelines of the plant it can be expected that the first few batches have a darker appearance than what would be expected. It is recommended to clean out the batcher by means of dry mixing (without bitumen) a few batches of aggregate.

### **5.2 Heating of drums (if applicable)**

Heating of drums shall be performed with an indirect heating system. Heating by means of open fire directly to the drum shell shall not be used since local overheating might compromise the quality of the binder.

Various type of heating systems are available such as electrical wire jackets or hot oil spiral type of drum heaters.

As soon as the binder is totally liquid the binder shall be decanted from the drum in the binder storage tank of the hot mix plant. The plant binder storage tank shall be equipped with an indirect heating systems such as electrical wiring or a thermal oil coil.

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### 5.3 Binder temperatures and storage regime.

Below the recommended binder temperatures are summarized.

	<b>Min</b>	<b>Recommended</b>	<b>Max</b>
Storage at mixing temperatures not longer than 10 days	160°C	165°C	170°C
Longer storage not exceeding one month	-	140°C	-
Maximum temperature of binder	-	-	180°C

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## 6 Batching process

Before production with Sealoflex Color asphalt, the asphalt plant must be cleaned by running 1-2 batches of only hot aggregates in the mixer. All other equipment (loaders, loading areas, canvas covers, paver, shovels, shoes, rollers) to be used for the job must be clean, remains of asphalt/bitumen must be removed as they can contaminate the product and give unintended effects. Don't use fuel or gasoline for cleaning.

If hot mix asphalt silos are used these should be cleaned as well prior to use of the colored asphalt.

The batching time is commonly hot mix batching plant specific. Following guidelines can be given:

After the heated aggregate enters the batch mixer the pigments shall be fed. In case no storage bin with feeding unit is available, the pigments shall be weighed by hand on a scale and fed to the batch mixer manually. The recommended mixing time of the aggregates with the pigments is 8-10 sec to allow the pigment to melt and the color to be distributed through the aggregate. After feeding the bitumen the recommended batching time is 28-35 sec.

As indicated the use of baghouse fines is not recommended if the fines have a dark coloured appearance. This can be due to the natural colour of the aggregates but also due to dust from external sources. In that case light coloured added filler should be used.

The asphalt trucks for transportation of the asphalt mix shall be covered with canvas covers to prevent excessive heat loss of the mix. The use of dedicated anti adhesive agents or vegetable oil is recommended to prevent excessive adhesion to the truck beds.

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## 7 Paving

For the hot mix paving ordinary asphalt laying equipment can be used. It is recommended to use a screed width of 80% of the maximum width and to build out the augers as wide as possible.

For the compaction steel wheel rollers are recommended. The use of a rubber tired roller is not recommended. The roller sequence is as follows:

- Use a steel wheel roller as breakdown roller and use vibration if required
- Use a static steel wheel roller for finishing compaction

Depending on the size of the paving surface each day, 2 or 3 rollers are required.

The finishing roller shall continue with rolling until the internal asphalt temperature is below 60°C. The Sealoflex color is an elastomeric binder which has the nature to recover from compaction action when at a temperature of 80-90°C. At lower temperatures this effect is negligible.

*Figure Paving colored asphalt*



A normal bitumen emulsion tack coat can be used under the coloured wearing course. Asphalt works must however not trespass the black tack coat and subsequently the finished coloured surface. This will leave shoe sole marks at the pavement which cannot be removed.

As a common procedure to decide actual paving method at site, a pre laying trials is recommended as a part of final laying approvals.

## **8 Curing time of Sealoflex color asphalt**

Ideally, asphalt (including Sealoflex color) should be allowed to cool to preferably about 25 Degrees before traffic hits the surface. In hot climates this might not be possible most parts of the year as the asphalt will only very slowly cool to around 30 - 35 degrees overnight. In view of this, if possible, traffic should be kept off the material for 24 - 48 hours (i.e. let the material settle overnight). If the site is located on private land (i.e. not a public highway) this time could be extended to 72 hours to assist the early life curing process.

## **9 General Maintenance of coloured surface**

Directly after paving the pavement surface will have a bright appearance which will darken slightly when the asphalt cures. Some few cases of whitish shade after compaction are known which disappears after a few weeks. Ultimately the bitumen coating at the top aggregates will wear off and the appearance of the surface will develop resemblance with the color of the aggregate.

It is not recommended that any solvents are used to clean asphalt surfaces as these will have a detrimental effect on the asphalt. We are not aware of any suitable proprietary cleaning agents which could be recommended for maintaining the colour and cleanliness of Sealoflex color asphalt surfacing. To retain the best possible colour, frequent sweeping of the surface (brushing with soapy water) is suggested and traffic management where possible in terms of restricting acceleration/ deceleration and general traffic speed is advised. Avoidance of vehicles turning their wheels on the spot, e.g. in a hammerhead turning area is strongly recommended.

Some discolouration from tyres is inevitable and the lighter the color of the asphalt, the more visible this will be. Even colored surfaces over time will still show blackish stains from vehicle tyres. It is not recommended that any chemicals to be used as they will be likely to disrupt the integrity of the asphalt as to remove rubber marks. The safest option is to manually brush the affected areas with soapy water to try to physically remove any black staining which may occur on the surface.

In case after time small scale repairs are necessary, a slurry seal in typical colours like red, green and blue can be supplied. This material is available in pails and is suitable for small scale and manual application.

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