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Efect Of The Use Of Medical Mask Waste As An Ingredient In Laston AC-BC Mixture To The Value Of Stability

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Abstract
The construction of highway construction is experiencing a very rapid development , especially in Indonesia and it is undeniable that highways are a vital sector of economic development in developed countries, Realizing the importance of toll roads for logistics delivery, the government continued to speed up its construction starting in 2015(Afriyanto, Indriyati and Hardini, 2019). Until 2018, the toll road that has been built along 782 Km. Development continues to date, the government targets the construction of toll roads in 2019 along 1,070 Km. Total toll road construction later, during the reign of President Jokowi reached 1,852 Km (Ariswa, Andriani and Irawan, 2020)
The COVID-19 pandemic is a very disturbing outbreak for Indonesian citizens and for the world since the beginning of the emergence of covid-19 in our country is required to adapt by implementing 3M (social distancing, wearing masks, and washing hands)(Wang *et al.*, 2022), the use of masks has become mandatory in this pandemic masses and due to overload the use of masks, especially 3 ply medical masks made of water-absorbing materials such as cotton on the final layer then the middle layer as a filter is made of materials such as non-woven polypropylene and the outer layer is made of waterproof materials such as polyester, in accordance with WHO advice the use of masks is required as an effort to break the chain of the covid-19 virus so that it does not spread widely but As a result of the use of masks with a high amount , of course, there is an effect on the environment that masks cannot be decomposed properly by the soil because physically the masks have Plastic-like characters are plastic that takes a long time to decompose with soil(Dong *et al.*, 2021).
Seeing the problem of medical mask waste p there is this new normal era, we are required to always innovate in order to adapt to the Covid-19 pandemic, in line with the leadership of President Jokowidodo who carries the advancement of infrastructure in Indonesia, especially in the highway sector, this study aims to utilize medical mask waste as a hot asphalt mixture material (Asphalt Hotmix) by using the experimental method of using waste masks with a composition of 5%, 7% and 10% as a substitute for asphalt which is reviewed on asphalt stabilit.

Keywords: Waste Mask Asphalt Hotmix , Stability, Covid-19 Pandemic

Abstrak
Pembangunan konstruksi jalan raya mengalami perkembangan yang sangar pesat terutama di Indonesia dan tidak dipungkiri lagi bahwa jalan raya merupakan sektor vital perkembangan ekonomi pada negara maju, Menyadari pentingnya jalan tol bagi pengiriman logistik, pemerintah terus mengebut pembangunannya mulai tahun 2015(Afriyanto, Indriyati and Hardini, 2019). Sampai tahun 2018, jalan tol yang telah terbangun sepanjang 782 Km. Pembangunan terus berlanjut hingga saat ini, pemerintah menargetkan pembangunan jalan tol tahun 2019 sepanjang 1.070 Km. Total pembangunan jalan tol nantinya, di masa pemerintahan Presiden Jokowi mencapai 1.852 Km (Ariswa, Andriani and Irawan, 2020)
Pandemic covid-19 merupakan wabah yang sangat meresakan bagi warga negara Indonesia maupun bagi dunia sejak awal kemunculan covid-19 di negara china kita di tuntut beradaptasi dengan dengan menerapkan 3M (menjaga jarak, memakai masker, dan mencuci tangan) (Wang *et al.*, 2022), penggunaan masker sudah menjadi kewajiban pada massa pandemic ini dan akibat overload penggunaan masker terutama masker medis 3 ply yang terbuat dari bahan penyerap air seperti kapas pada lapisan akhir kemudian lapisan tengah sebagai filter terbuat dari bahan seperti polipropilena non-anyaman dan lapisan luar terbuat dari bahan tahan air seperti polyester, sesuai dengan saran WHO penggunaan masker diwajibkan sebagai upaya pemutus rantai virus covid-19 agar tidak menyebar luas namun sebagai dampak penggunaan masker dengan jumlah yang tinggi tentunya ada efek bagi lingkungan masker tidak dapat terurai dengan baik oleh tanah dikarenakan secara fisik masker memiliki karakter seperti plastik yaitu plastis yang membutuhkan waktu lama dapat terurai dengan tanah (Dong *et al.*, 2021).
Melihat permasalahan limbah masker medis pada era new normal ini kita dituntut untuk selalu berinovasi agar dapat beradaptasi dengan pandemic covid-19, selaras dengan masa kepemimpinan Presiden Jokowidodo yang mengusung kemajuan insfrastruktur di negara Indonesia terutama pada sektor jalan raya, penelitian ini bertujuan untuk memanfaatkan limbah masker medis sebagai bahan campuran aspal panas (Asphalt Hotmix) dengan menggunakan metode ekperimental penggunaan limbah masker dengan komposisi 5%, 7% dan 10% sebagai bahan pengganti aspal yang ditinjau pada Stabilitas aspal.

Kata Kunci: Limbah Masker, Asphalt Hotmix ,Stabilitas ,Pandemic Covid-19

INTRODUCTION

Transportation technology, especially road constructions have undergone rapid development. It is characterized by the increasingly smooth flow of land transportation(Tran *et al.*, 2022). The reliability of technology and science is highly expected to face challenges in increasing the quantity and quality of roads to be built and in the maintenance period. For this reason, a road construction overburden technology that has structural value has been born which was first developed in America by the Asphalt Institute under the name Asphalt Concrete (AC) is expected to be able to provide a relatively longer technical life and can reduce premature damage to the road surface(Alvarado-Robles *et al.*, 2021). Laston as a layer of road surface that is considered to have many advantages such as waterproofness, relatively fast processing time and can be passed by vehicles after spreading(Bar-Yosef and Schick, 1989).

Along with the development of asphalt mixture innovation at the end of 2019, the world was shocked by the emergence of a pneumonia-like virus whose cause is

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unknown. The acute respiratory infection that attacked the lungs was detected in the city of Wuhan, Hubei Province, China. According to authorities, some of the patients were traders operating at Huanan Fish Market and the new virus is now better known as Covid-19(Pugin *et al.*, 2022).

The Covid-19 outbreak has been going on for more than 1 year and in Indonesia has implemented the New Normal Era policy, in the New Normal Era people are required to be active in innovating inseparable as an engineer must also be able to innovate in the pandemic masses, the use of masks is a mandatory equipment for all humans and the result of excessive use of masks , especially on medical masks 1x wear And of course it will cause the effect of mask waste that can pollute the environment both for nature and for surrounding animals.

Responding to the challenges of the New Normal Era, this research utilizes medical masks as a hot asphalt mixture in accordance with and in line with the rapid progress of President Jokowidodo's leadership which continues to improve infrastructure, especially on highways, is expected to utilize mask waste as a hot asphalt mixture using experimental methods with a mixed composition of 5%, 7% and 10% medical mask waste as a substitute for asphalt reviewed on the stability of asphalt carried out laboratory testing in accordance with National and International Standards(Pugin *et al.*, 2022).

LITERATURE REVIEW

HOT ASPHALT MIX TYPE

Types of asphalt concrete are distinguished by the mixing temperature of the asphalt concrete forming material(Dong *et al.*, 2022). Based on the temperature when mixing and compacting the asphalt concrete mixture, it can be distinguished by:

1. Hot mix asphalt concrete (*hotmix*), is asphalt concrete whose forming material is mixed at a mixing temperature of about 140°C.
2. Medium capuran asphalt concrete (*warmmix*), is asphalt concrete whose forming material is mixed at a mixing temperature of about 60°C.
3. Hot capuran asphalt concrete (*coldmix*), is asphalt concrete whose forming material is mixed at a mixing temperature of about 25°C.
4. Asphalt concrete for *wearing course*, is a pavement layer that is directly related to vehicle tires, is a layer that is waterproof, resistant to weather, and has the required roughness.
5. Asphalt concrete for the foundation layer (*binder course*), is a pavement layer located under the wear layer. It is not directly related to the weather, but it is necessary to have stability to carry the traffic load devolved through the wheels of the vehicle.
6. Asphalt concrete for forming and leveling old asphalt concrete layers, which are generally worn out and often not *crown-shaped*.

Currently in Indonesia there are various types of hot mixed asphalt concrete used for road pavement coatings. The difference lies in the type of aggregate gradation and asphalt content used. The selection of the type of asphalt concrete to be used at a site, is largely determined by the type of asphalt concrete characteristics that are preferred. For example, if road pavement is planned to be used to serve heavy vehicular traffic, then the nature of stability takes precedence(Salari *et al.*, 2019; Ariswa, Andriani and Irawan, 2020; Pugin *et al.*, 2022). This means the most suitable type of asphalt concrete is asphalt concrete which has a well-graded mixed aggregate. The selection of this type of asphalt concrete has the consequence that the pores in the mixture become small, the content of asphalt that can be mixed is also reduced, so that the asphalt blanket becomes thinner. The types of hot mix asphalt concrete that exist in Indonesia today are:

1. Laston (Concrete Asphalt Coating), is a continuously graded asphalt concrete that is commonly used for roads with heavy traffic loads. Laston is known, the most important thing in this mixture is stability. Minimum nominal thickness of Laston 4-7.5 cm (General Specification of Bina Marga 2010). According to its function, laston has 3 kinds of mixtures(Salari *et al.*, 2019), namely:
   a. Laston as a wear layer, known by the name of AC-WC (*Asphalt Concrete - Wearing Course*). The minimum nominal thickness of AC-WC is 4 cm.
   b. Laston as a binding layer, known by the name of AC-BC (*Asphalt Concrete - Binder Course*). The minimum nominal thickness of AC-BC is 6 cm.
   c. Laston as the foundation layer, known as AC-Base (*Asphalt Concrete - Base*). The minimum nominal thickness of AC-Base is 7.5 cm.
2. Lataston (Thin Layer of Concrete Asphalt), is a parallel graded asphalt concrete. Lataston is also commonly referred to as HRS (*Hot Rolled Sheet*).
3. Latasir (Thin Layer of Sand Asphalt), is asphalt concrete for roads with light traffic, especially where coarse aggregates are not or are difficult to obtain.
4. The leveling layer is asphalt concrete that is used as a leveling layer anda cross-sectional k builder on the old road surface.

CONSTITUENT ELEMENTS OF HOT ASPHALT MIXTURE

The composition of the plan of the AC-BC mixture is within the limits of the plans given in the following table :

Table 1
Laston AC-BC Nature Provisions

Properties of the mixture		Laston					
		Wear Layer		Intermediate Layers		Foundation	
		Soft	Rough	Soft	Rough	Soft	Rough
Effective asphalt content (%)		5,1	4,3	4,3	4,0	4,0	3,5
Asphalt absorption (%)	Max.	12					
Number of collisions per field		75		112			
Cavities in the mixture (%)	Min.	3,5					
	Max.	5,0					
Cavities in aggregates (VMA) (%)	Min.	15	14	13			
Asphalt-filled cavities (%)	Min.	65	63	60			
Marshall stability (kg)	Min.	800		1800			
	Max.	-		-			

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Melting(mm)	Min.	3	4,5
Marshall Quotient (kg/mm)	Min.	250	300
Residual Marshall stability (%) after soaking for 24 hours, 60°C	Min.	90	
Cavities in the mixture (%) at a compound density (refusal)	Min.	2,5	

Source : General Specification of Division VI, Bina Marga, 2010

HARD ASPHALT / ASPHALT CONCRETE

Cement asphalt at room temperature (25°-30°C) is solid(Fikri, Subagja and Manurung, 2019; Hadid, Ubudiyah and Apriyani, 2020). Cement asphalt consists of several types depending on the manufacturing process and the type of petroleum origin(Afriyanto, Indriyati and Hardini, 2019). grouping cement asphalt can be done based on penetration value at 25 °C or based on its viscosity value. In Indonesia, cement asphalt is usually distinguished by its penetration value, namely:

1. AC pen 40/50, which is an air conditioner with penetration between 40/50.
2. AC pen 60/70, which is an air conditioner with penetration between 60-70.
3. AC pen 85-100, which is an air conditioner with penetration between 85-100.
4. AC pen 120/150, which is an air conditioner with penetration between 120-150.
5. AC pen 200//300, which is an air conditioner with penetration between 200-300.

Asphalt cement with low penetration is used in hot-weather areas or high-volume traffic, while high-penetration asphalt cement is used in cold-weather areas or low-volume traffic. In Indonesia, asphalt cement is generally used with a penetration of 60/70 and a penetration of 80/100(Widayanti *et al.*, 2020).

Table 2
Terms – Hard Asphalt Provisions

No	Types of Testing	Test Methods	Type I Asphalt Pen 60-70	Type II Modified Asphalt		
				A	B	c
				Asbuton In Process	Natural Elastomer (Latex)	Synthesis elastomers
1	Penetration At 25°C (mm)	SNI 06-2456-1991	60-70	40-55	50-70	Min.40
2	Vision 135°C	SNI 06-6441-2000	385	385-2000	≤2000	≤3000
3	Mushy Point (°C)	SNI 06-2434-1991	≥48	-	-	≥54
4	Penetration Index	-	≥-1.0	≥-0.5	≥0.0	≥0.4
5	Ductility at 25°C (cm)	SNI 06-2432-1991	≥100	≥100	≥100	≥100
6	Flash Point (°C)	SNI 06-2433-1991	≥232	≥232	≥232	≥232
7	Solubility In Toluene (%)	ASTM-D5546	≥99	≥90	≥99	≥99
8	Specific Gravity	SNI 06-2441-1991	≥1.0	≥1.0	≥1.0	≥1.0
9	Storage Stability (°C)	ASTM D 5976 part 6.1	-	≤2.2	≤2.2	≤2.2
	Residual Testing of TFOT or RTFOT results:					
10	Lost Weight (%)	SNI 06-6441-1991	≤0.8	≤0.8	≤0.8	≤0.8
11	Penetration at 25°C (%)	SNI 06-2456-1991	≥54	≥54	≥54	≥54
12	Penetration Index	-	≥-1.0	≥0.0	≥0.0	≥0.4
13	Elasticity After Return (%)	AASHTO 301-98	-	-	≥45	≥60
14	Ductility at 25°C (cm)	SNI 06-2432-1991	≥100	≥50	≥50	-
15	Particles Finer Than 150 Microns (hours) (%)	-	-	Min.95	Min.95	Min.95

Source : General Specification of Division VI, Bina Marga, 2010

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METHOD

Method research Done with Testing laboratory appropriate with Standard Indonesia SK SNI And standard foreign that is ASTM

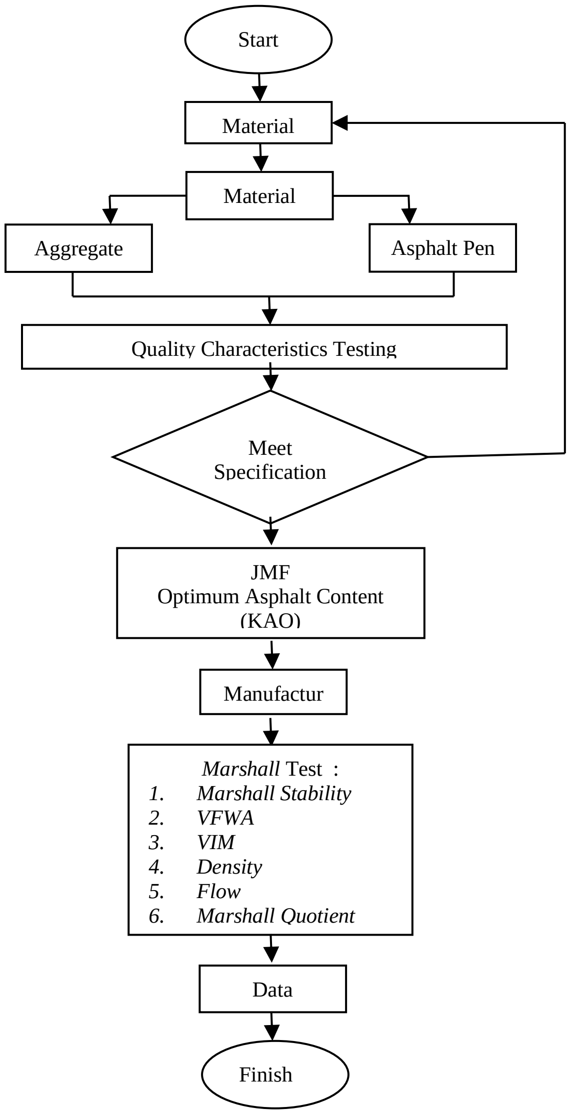

Figure 1. *Flow Chart*

Material Testing

1. Asphalt Testing
   a. Penetration test
   The purpose of this test is to determine the penetration of hard asphalt by inserting a penetration needle of a certain size, load and time into the asphalt at a certain temperature using a set of penetration test equipment(Putri *et al.*, 2019).
   b. Asphalt flaccid point
   This research aims to determine the mushy point of asphalt which ranges from 30 o C to 200 ^{o}C . What is meant by mushy point is the temperature on the steel ball, with a certain weight, pressing down so that the layer of asphalt is retained in a certain size of the ring, so that the asphalt touches the base plate located under the ring at a certain height, as a result of the heating carried out(Tran *et al.*, 2022)
   c. Inspection of the specific gravity of asphalt
   This examination aims to determine the specific gravity of asphalt using a picnometer. The specific gravity of asphalt is the ratio between the weight of asphalt and the weight of distilled water with the same content at a certain temperature(Alvarado-Robles *et al.*, 2021).

Table 4
Specification of Asphalt Testing

No.	Test specifications	Asphalt type	Standard	Origin of the material
1.	Penetration test	Pen 60 / 70	SNI 06-2456-1991	Civil Engineering Laboratory of Lamongan Islamic University
2.	Specific gravity and absorption test	Pen 60 / 70	SNI 06-2441-1991	Civil Engineering Laboratory of Lamongan Islamic University
3.	Test flaccid point	Pen 60 / 70	SNI 06-2434-1991	Civil Engineering Laboratory of Lamongan Islamic University
4.	Flash point and burn point test	Pen 60 / 70	SNI 06-2433-1991	Civil Engineering Laboratory of Lamongan Islamic University

Source : Indonesian National Standard

Aggregate Testing

a. Specific gravity and absorption of coarse aggregates and fine aggregates
This test aims to determine the specific gravity of coarse and fine aggregates under SSD (*Surface Saturated* Dry) conditions, *Bulk Specific* Gravity Dry, pseudo-conditions (*Apperant SpesificGravity*), and absorption of coarse and fine aggregates.
b. Analysis of fine and coarse aggregate sieves
The purpose of this test is to determine the fine and coarse grain (gradation) of the aggregate by using a sieve

Table 5
Rough Aggregate Testing Specifications

No.	Test specifications	Aggregate type	Standard	Origin of the material
1.	Test the weight of the contents and air cavities in the aggregate	Sizes 1-1; 1-2 and 1-3	SK SNI 03-4804-1998	Civil Engineering Laboratory of Lamongan Islamic University
2.	Specific gravity and absorption test	Sizes 1-1; 1-2 and 1-3	SK SNI 1969-2008	Civil Engineering Laboratory of Lamongan Islamic University

Source : Indonesian National Standard

Table 6
Fine Aggregate Testing Specifications

No.	Test specifications	Aggregate type	Standard	Origin of the material
1.	Sand fill weight test	Natural sand	SK SNI 03-4804-1998	Civil Engineering Laboratory of Lamongan Islamic University
2.	Specific gravity and sand absorption test	Natural sand	SK SNI 1970-2008	Civil Engineering Laboratory of Lamongan Islamic University

Source : Indonesian National Standard

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RESULTS AND DISCUSSION

The results of the study were carried out with laboratory tests in accordance with SNI (Indonesian national standards), laboratory tests were carried out on material analysis including analysis of fine aggregate, rough aggregate and asphalt.

Fine Aggregat Examination Results

The results of the smooth aggregate laboratory test analysis are carried out in accordance with the SNI Decree 1969-2008, namely by testing bulk specific gravity, SSD specific gravity, pseudo-specific gravity and fine aggregate water absorption with the following analysis results:

Table 7. Fine Aggregate Testing

No.	Types of testing	Test Methods	Unit	Result	Condition
1.	**Coarse Aggregates**				
	Bulk Specific Gravity (*Bulk*)	SK SNI 1969-2008	Gr/cc	2,51	≥ 2.5
	Specific gravity of SSD	SK SNI 1969-2008	Gr/cc	2,55	≥ 2.5
	Pseudo-Specific Gravity	SK SNI 1969-2008	%	2,62	≥ 2.5
	Water absorption	SK SNI 1969-2008	%	1,65	≤ 3.0

Source : laboratory research results, 2023

From the results of the fine aggregate analysis, values were obtained in accordance with the standards of the SNI Decree 1969-2008 and it was stated that fine aggregate materials could be used in the job mix formula.

Results of Rough Aggregat Examination

The results of the rough aggregate laboratory test analysis are carried out in accordance with the SNI Decree 1969-2008, namely by testing bulk specific gravity, SSD specific gravity, pseudo-specific gravity and rough aggregate water absorption with the following analysis results:

Table 8. Fine Aggregate Testing

No.	Types of testing	Test Methods	Unit	Result	Condition
1.	**Coarse Aggregates**				
	Bulk Specific Gravity (*Bulk*)	SK SNI 1969-2008	Gr/cc	2,56	≥ 2.5
	Specific gravity of SSD	SK SNI 1969-2008	Gr/cc	2,61	≥ 2.5
	Pseudo-Specific Gravity	SK SNI 1969-2008	%	2,68	≥ 2.5
	Water absorption	SK SNI 1969-2008	%	1,79	≤ 3.0

Source : laboratory research results, 2023

From the results of the fine aggregate analysis, values were obtained in accordance with the standards of the SNI Decree 1969-2008 and it was stated that coarse aggregate materials could be used in the job mix formula.

Asphalt Inspection Results

The results of the asphalt examination laboratory test analysis are carried out by conducting Penetration testing, Flaccid Point, Flash Point, Burn Point and specific gravity of asphalt with the following analysis results:

Table 9. Asphalt Testing

No.	Types of Examinations	Result	Condition
1.	Penetration, 100 gr, 25°C, 5 seconds	67	60 – 79
2.	Mushy Point	49,5	48°C - 58°C
3.	Flash Point	329	Min. 200°C
4.	Burn Point	334	Min. 300°C
6.	Specific gravity	1,0209	Min. 1.00

Source : laboratory research results, 2023

Job mix formula

In planning the proportion of the aggregate mixture Laston AC-BC is obtained by the following working procedure :

1.Understand the required gradation limitations.
2.Enter the required specification data.

After obtaining the composition of the working mixture, then weighing is carried out according to the proportion of the Laston AC-BC mixture with the following proportions of the mixture :

Table 10. Gradation of Aggregates In Mixn

No.	Materials	Proportion
1.	Aggregate Kasar (*Coarse Aggregate / CA*)	39%
2.	Aggregate Sedang (*Medium Aggregate / MA)*	50%
3.	Fine Aggregate (*Fine Aggregate /FA)*	7%
4.	Pasir Natural (*Natural Sand/NS)*	4%
Total		100%

Source : laboratory research results, 2023

In accordance with the composition above, an aggregate merger is carried out which is presented in the form of a table as follows :

Table 13. Job mix formula mix test object mixture 1100 gr

Asphalt	Medical Masks	Medical Mask Weight	Asphalt Weight	CA 39 %	MA 50 %	FA 7%	NS 4%	Total
%	%	Gr	Gr	Gr	Gr	Gr	Gr	Gr
5,61	0	0,000	65,378	403,503	517,311	72,424	41,385	1100
5,61	2	1,307	65,070	403,503	517,311	72,424	41,385	1100
5,61	4	2,615	62,762	403,503	517,311	72,424	41,385	1100
5,61	6	3,922	61,455	403,503	517,311	72,424	41,385	1100

Source : laboratory research results, 2023

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Marshall Test

Marshall Test is carried out in accordance with applicable standards, namely RSNI 3-2489-2014 Stability test method and melting of hot paved mixture using Marshall tool and obtained the following results :

Table 14. Marshall Test Results

% agg	% Test Objects	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	correction	q	r	MQ
94,06	0%	6,32	5,61	1069	1086	607	479,00	2,23	2,34	12,26	81,94	5,80	18,06	67,89	4,54	200	735,5	1,03	756,21	7	105,07
94,06	0%	6,32	5,61	1078	1100	628	472,00	2,28	2,34	12,55	83,85	3,60	16,15	77,72	2,30	210	772,3	1,02	787,70	3	257,42
94,06	0%	6,32	5,61	1065	1103	632	471,00	2,26	2,34	12,43	83,02	4,56	16,98	73,16	3,28	290	1066,4	1,03	1100,38	4	266,61
94,06	2%	6,19	5,61	1053	1086	618	468,00	2,25	2,34	12,36	82,61	5,03	17,39	71,09	4,03	175	643,5	1,04	671,04	4	160,89
94,06	2%	6,19	5,61	1061	1090	622	468,00	2,27	2,34	12,46	83,23	4,31	16,77	74,31	3,30	160	588,4	1,04	609,24	3	196,13
94,06	2%	6,19	5,61	1066	1097	604	493,00	2,16	2,34	11,88	79,39	8,73	20,61	57,64	7,78	130	478,1	1,03	492,84	8	59,76
94,06	4%	6,07	5,61	1072	1100	628	472,00	2,27	2,35	12,48	83,38	4,13	16,62	75,12	3,41	170	625,2	1,03	641,07	6	104,19
94,06	4%	6,07	5,61	1066	1091	621	470,00	2,27	2,35	12,46	83,27	4,27	16,73	74,50	3,54	220	809,0	1,03	834,03	3	269,68
94,06	4%	6,07	5,61	1055	1088	602	486,00	2,17	2,35	11,93	79,70	8,37	20,30	58,76	7,68	150	551,6	1,04	574,18	4	137,90
94,06	6%	5,94	5,61	1056	1117	633	484,00	2,18	2,36	11,99	80,10	7,91	19,90	60,26	7,48	215	790,6	1,04	822,27	4	197,66
94,06	6%	5,94	5,61	1053	1075	607	468,00	2,25	2,36	12,36	82,61	5,03	17,39	71,09	4,59	275	1011,3	1,04	1054,49	2	505,64
94,06	6%	5,94	5,61	1064	1103	626	477,00	2,23	2,36	12,26	81,90	5,85	18,10	67,70	5,41	340	1250,3	1,03	1291,24	2	625,16

Source : laboratory research results, 2023

Description :

a = asphalt content to aggregate, (%)
b = Asphalt content (and additives) thd mixture, (%)
c = dry weight b.u. (before soaking), (gr)
d = dry weight b.u. SSD state, (gr)
e = weight of b.u. in water, (gr)
f = volume b.u. = d - e, (cc)
g = weight of volume b.u. = c/f, (gr/cc)
h = B.J.maximum theoretical, (gr/cc)
i = volume of asphalt
j = Bj. Aggregate effective
k = cavity level in camp
l = cavity levels in aggr. (VMA)
m = asphalt-filled cavity (VFA)
n = cavity thd camp. (VIM)
o = pembac value. Stability watch
p = profing ring
q = stability = p x correction thickness b.u., (kg)
r = plastic melt (flow), (mm)
MQ = Marshall Quotient, (kg/mm)

Table 15. Average marshall test results

(%) medical masks	Stability(kg)	VFWA (%)	VIM (%)	VMA (%)	Flow (mm)	MQ (Kg/mm)
0	858	72,9	3,4	17,1	4,7	209,7
2	570	67,7	5,0	18,3	5,0	138,9
4	662	69,5	4,9	17,9	4,3	170,6
6	1017	66,4	5,8	18,5	2,7	442,8
Specifications	> 800	> 65	3,0 - 5,0	> 14	2,0 - 4,0	> 250
Compaction	2 × 75					
Asphalt Content	5,61%					

Source : laboratory research results, 2023

Picture. 5 Process compact test object and marshall test testing

CONCLUSION

From the results of research that has been carried out the addition of medical mask waste to the asphalt mixture, the following conclusions were obtained:

1. The results of the marshall test with a stability specification of >800 kg, showed that the medical mask mixture at a percentage of 6% increased by 1,017 kg compared to the normal mixture of 0% having a stability value of 858 kg.
2. The results of calculating the MQ value with a specification of >250 kg / mm a percentage of 6% have the largest value of 442.8 kg / mm and in the normal mixture have a value of 209.7 kg / mm
   From the results of the research conducted, the results of VFWA, VIM, VMA and Flow have values that are in accordance with specifications

SUGGESTION

Suggestions on the research that has been carried out are as follows:

1. Do research using medical mask waste with different percentages
2. Try using a different type of asphalt but still use medical mask waste as an added material.
3. Take advantage of medical waste that is only disposable in research

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