LAMPIRAN

Lampiran 1 Komposisi Campuran Beraspal Panas untuk Memperoleh Kadar Aspal Optimum pada Aspal Pen. 60 (Benda Uji 1)

Ukuran Material		% Tertahan Desain	Notasi	Berat Jenis (G)		Notasi	Komposisi Campuran Terhadap Berat Total Campuran (%)				
				Curah	Semu		5	5,5	6	6,5	7
1/2 inch	12,7 mm	10	G1	2,374	2,483	P1	9,5	9,45	9,4	9,35	9,3
3/8 inch	9,52 mm	10	G2	2,458	2,576	P2	9,5	9,45	9,4	9,35	9,3
No. 4	4,76 mm	20	G3	2,713	2,843	P3	19	18,9	18,8	18,7	18,6
No. 8	2,38 mm	17,5	G4	2,538	2,647	P4	16,625	16,5375	16,45	16,3625	16,275
No. 30	0,59 mm	19	G5	2,486	2,596	P5	18,05	17,955	17,86	17,765	17,67
No. 50	0,297 mm	5,5	G6	2,472	2,58	P6	5,225	5,1975	5,17	5,1425	5,115
No. 100	0,149 mm	6	G7	2,521	2,623	P7	5,7	5,67	5,64	5,61	5,58
No. 200	0,074 mm	5	G8	2,501	2,604	P8	4,75	4,725	4,7	4,675	4,65
Pan		7	G9	2,680	2,680	P9	6,65	6,615	6,58	6,545	6,51
Total Agregat		100	Gs			Ps	95,0	94,5	94,0	93,5	93,0
Berat Jenis Curah (Gsb), Agregat Total							2,538	2,538	2,538	2,538	2,538
Berat Jenis Semu (Gsa), Agregat Total							2,644	2,644	2,644	2,644	2,644
Berat Jenis Efektif (Gse), Agregat Total							2,591	2,591	2,591	2,591	2,591
Berat Jenis Aspal (Gb)							1,03	1,03	1,03	1,03	1,03
Berat Jenis Maksimum (Gmm), Campuran							2,408	2,391	2,375	2,358	2,342
Berat Kering (Bk), (gram)							1195,0	1201,5	1212,5	1216,2	1215,3
Berat Kering Permukaan Jenuh (Bssd), (gram)							1206,0	1212,5	1219,0	1219,3	1222,4
Berat dalam Air (Ba), (gram)							669	677	684	688	692
Kepadatan (Gmb)							2,225	2,244	2,266	2,289	2,291
Kadar Aspal Terserap (Pba), (%)							0,83	0,83	0,83	0,83	0,83
Kadar Aspal Efektif (Pbe), (%)							4,21	4,71	5,22	5,72	6,23
Rongga dalam Mineral Agregat (VMA), (%)							16,7	16,4	16,0	15,7	16,0
Rongga dalam Campuran (VIM), (%)							7,6	6,2	4,6	2,9	2,2

Lampiran 2 Komposisi Campuran Beraspal Panas untuk Memperoleh Kadar Aspal Optimum pada Aspal Pen. 60 (Benda Uji 2)

Ukuran Material		% Tertahan Desain	Notasi	Berat Jenis (G)		Notasi	Komposisi Campuran Terhadap Berat Total Campuran (%)				
				Curah	Semu		5	5,5	6	6,5	7
1/2 inch	12,7 mm	10	G1	2,374	2,483	P1	9,5	9,45	9,4	9,35	9,3
3/8 inch	9,52 mm	10	G2	2,458	2,576	P2	9,5	9,45	9,4	9,35	9,3
No. 4	4,76 mm	20	G3	2,713	2,843	P3	19	18,9	18,8	18,7	18,6
No. 8	2,38 mm	17,5	G4	2,538	2,647	P4	16,625	16,5375	16,45	16,3625	16,275
No. 30	0,59 mm	19	G5	2,486	2,596	P5	18,05	17,955	17,86	17,765	17,67
No. 50	0,297 mm	5,5	G6	2,472	2,58	P6	5,225	5,1975	5,17	5,1425	5,115
No. 100	0,149 mm	6	G7	2,521	2,623	P7	5,7	5,67	5,64	5,61	5,58
No. 200	0,074 mm	5	G8	2,501	2,604	P8	4,75	4,725	4,7	4,675	4,65
Pan		7	G9	2,680	2,680	P9	6,65	6,615	6,58	6,545	6,51
Total Agregat		100	Gs			Ps	95,0	94,5	94,0	93,5	93,0
Berat Jenis Curah (Gsb), Agregat Total							2,538	2,538	2,538	2,538	2,538
Berat Jenis Semu (Gsa), Agregat Total							2,644	2,644	2,644	2,644	2,644
Berat Jenis Efektif (Gse), Agregat Total							2,591	2,591	2,591	2,591	2,591
Berat Jenis Aspal (Gb)							1,03	1,03	1,03	1,03	1,03
Berat Jenis Maksimum (Gmm), Campuran							2,408	2,391	2,375	2,358	2,342
Berat Kering (Bk), (gram)							1193,6	1212,3	1210,4	1211,7	1211,0
Berat Kering Permukaan Jenuh (Bssd), (gram)							1209,5	1218,6	1224,3	1220,1	1220,2
Berat dalam Air (Ba), (gram)							669	678	691	690	691
Kepadatan (Gmb)							2,208	2,243	2,270	2,286	2,288
Kadar Aspal Terserap (Pba), (%)							0,83	0,83	0,83	0,83	0,83
Kadar Aspal Efektif (Pbe), (%)							4,21	4,71	5,22	5,72	6,23
Rongga dalam Mineral Agregat (VMA), (%)							17,3	16,5	15,9	15,8	16,1
Rongga dalam Campuran (VIM), (%)							8,3	6,2	4,4	3,1	2,3

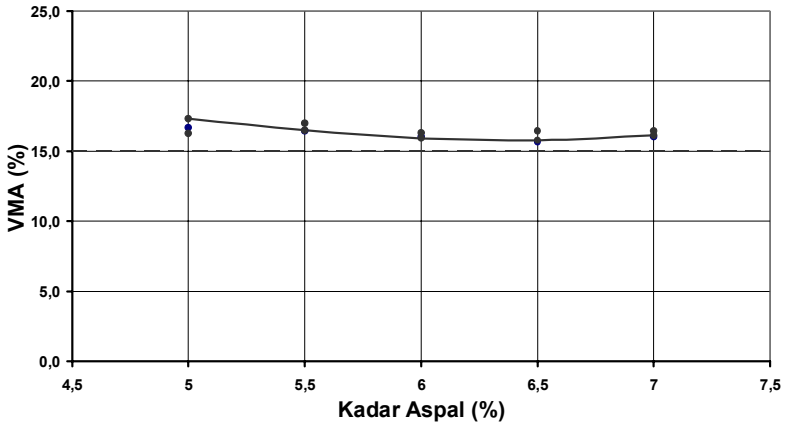
Lampiran 3 Komposisi Campuran Beraspal Panas untuk Memperoleh Kadar Aspal Optimum pada Aspal Pen. 60 (Benda Uji 3)

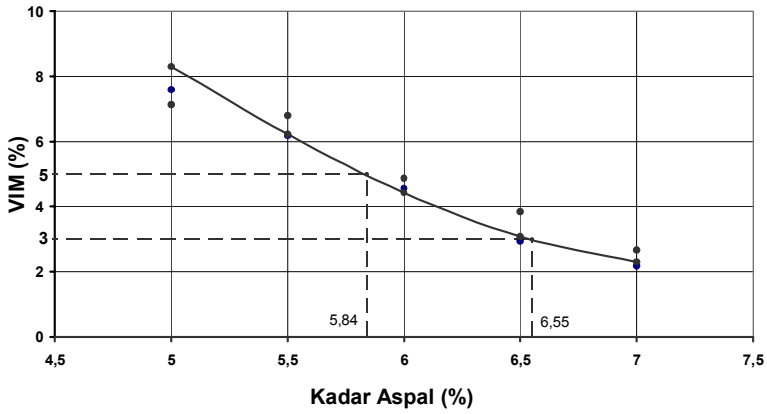
Ukuran Material		% Tertahan Desain	Notasi	Berat Jenis (G)		Notasi	Komposisi Campuran Terhadap Berat Total Campuran (%)				
				Curah	Semu		5	5,5	6	6,5	7
1/2 inch	12,7 mm	10	G1	2,374	2,483	P1	9,5	9,45	9,4	9,35	9,3
3/8 inch	9,52 mm	10	G2	2,458	2,576	P2	9,5	9,45	9,4	9,35	9,3
No. 4	4,76 mm	20	G3	2,713	2,843	P3	19	18,9	18,8	18,7	18,6
No. 8	2,38 mm	17,5	G4	2,538	2,647	P4	16,625	16,5375	16,45	16,3625	16,275
No. 30	0,59 mm	19	G5	2,486	2,596	P5	18,05	17,955	17,86	17,765	17,67
No. 50	0,297 mm	5,5	G6	2,472	2,58	P6	5,225	5,1975	5,17	5,1425	5,115
No. 100	0,149 mm	6	G7	2,521	2,623	P7	5,7	5,67	5,64	5,61	5,58
No. 200	0,074 mm	5	G8	2,501	2,604	P8	4,75	4,725	4,7	4,675	4,65
Pan		7	G9	2,680	2,680	P9	6,65	6,615	6,58	6,545	6,51
Total Agregat		100	Gs			Ps	95,0	94,5	94,0	93,5	93,0
Berat Jenis Curah (Gsb), Agregat Total							2,538	2,538	2,538	2,538	2,538
Berat Jenis Semu (Gsa), Agregat Total							2,644	2,644	2,644	2,644	2,644
Berat Jenis Efektif (Gse), Agregat Total							2,591	2,591	2,591	2,591	2,591
Berat Jenis Aspal (Gb)							1,03	1,03	1,03	1,03	1,03
Berat Jenis Maksimum (Gmm), Campuran							2,408	2,391	2,375	2,358	2,342
Berat Kering (Bk), (gram)							1199,6	1215,8	1214,5	1219,6	1220,4
Berat Kering Permukaan Jenuh (Bssd), (gram)							1211,4	1226,5	1224,6	1227,8	1227,3
Berat dalam Air (Ba), (gram)							675	681	687	690	692
Kepadatan (Gmb)							2,236	2,229	2,259	2,268	2,280
Kadar Aspal Terserap (Pba), (%)							0,83	0,83	0,83	0,83	0,83
Kadar Aspal Efektif (Pbe), (%)							4,21	4,71	5,22	5,72	6,23
Rongga dalam Mineral Agregat (VMA), (%)							16,3	17,0	16,3	16,4	16,4
Rongga dalam Campuran (VIM), (%)							7,1	6,8	4,9	3,8	2,7

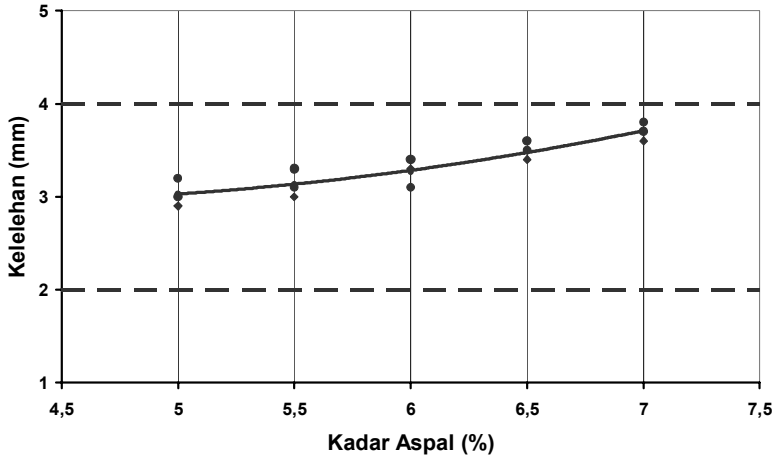
Lampiran 4 Hasil Pengujian Marshall untuk Memperoleh Kadar Aspal Optimum pada Aspal Pen. 60

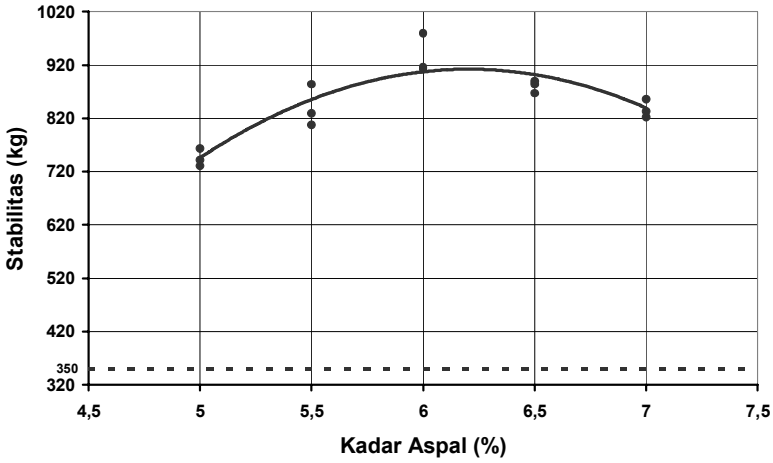
Kadar Aspal	Nomor Benda Uji	Berat Benda Uji			Bulk Volume (ml)	Faktor Koreksi	Kepadatan (gr/ml)	VMA (%)	VIM (%)	Pembacaan Stabilitas	Stabilitas Marshall (kg)	Kelelehan (mm)	Marshall Quotient (kg/mm)
		Kering (gr)	Kering Permukaan Jenuh (gr)	Dalam Air (gr)									
5	1	1195,0	1206,0	669	537,0	0,93	2,225	16,7	7,6	68,0	741,8	2,9	255,8
	2	1193,6	1209,5	669	540,5	0,93	2,208	17,3	8,3	67,0	730,9	3,0	243,6
	3	1199,6	1211,4	675	536,4	0,93	2,236	16,3	7,1	70,0	763,6	3,2	238,6
Rata -rata							2,223	16,8	7,7	68,3	745,4	3,0	245,7
5,5	1	1201,5	1212,5	677	535,5	0,93	2,244	16,4	6,2	74,0	807,3	3,0	269,1
	2	1212,3	1218,6	678	540,6	0,93	2,243	16,5	6,2	81,0	883,6	3,3	267,8
	3	1215,8	1226,5	681	545,5	0,93	2,229	17,0	6,8	76,0	829,1	3,1	267,4
Rata -rata							2,238	16,6	6,4	77,0	840,0	3,1	268,1
6	1	1212,5	1219,0	684	535,0	0,96	2,266	16,0	4,6	87,0	979,7	3,3	296,9
	2	1210,4	1224,3	691	533,3	0,96	2,270	15,9	4,4	81,0	912,1	3,4	268,3
	3	1214,5	1224,6	687	537,6	0,93	2,259	16,3	4,9	84,0	916,3	3,1	295,6
Rata -rata							2,265	16,1	4,6	84,0	936,1	3,3	286,5
6,5	1	1216,2	1219,3	688	531,3	0,96	2,289	15,7	2,9	79,0	889,6	3,4	261,6
	2	1211,7	1220,1	690	530,1	0,96	2,286	15,8	3,1	77,0	867,1	3,6	240,9
	3	1219,6	1227,8	690	537,8	0,93	2,268	16,4	3,8	81,0	883,6	3,5	252,5
Rata -rata							2,281	16,0	3,3	79,0	880,1	3,5	251,5
7	1	1215,3	1222,4	692	530,4	0,96	2,291	16,0	2,2	73,0	822,0	3,6	228,3
	2	1211,0	1220,2	691	529,2	0,96	2,288	16,1	2,3	76,0	855,8	3,7	231,3
	3	1220,4	1227,3	692	535,3	0,96	2,280	16,4	2,7	74,0	833,3	3,8	219,3
Rata -rata							2,286	16,2	2,4	74,3	837,1	3,7	226,3

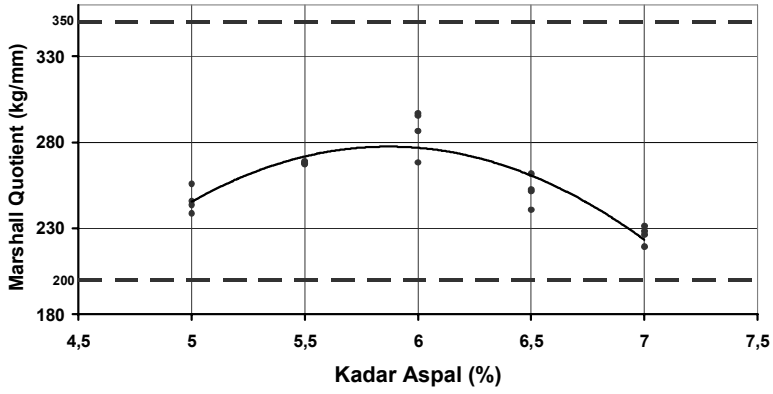
Lampiran 5 Hubungan Kadar Aspal Pen. 60 dengan Parameter Marshall

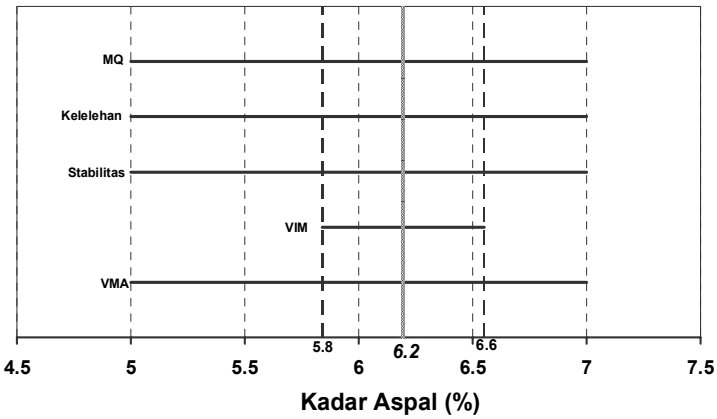







1020
920
820
720
620
520
420
350
320
Stabilitas (kg)
4,5
5
5,5
6
6,5
7
7,5
Kadar Aspal (%)


350
330
280
230
200
180
Marshall Quotient (kg/mm)
4,5
5
5,5
6
6,5
7
7,5
Kadar Aspal (%)


MQ
Kelelehan
Stabilitas
VIM
VMA
5.8
6.2
6.6
4.5
5
5.5
6
6.5
7
7.5
Kadar Aspal (%)

Lampiran 6 Komposisi Campuran Beraspal Panas pada Kadar Aspal Optimum tanpa Perendaman

Ukuran Material		% Tertahan Desain	Notasi	Berat Jenis (G)		Notasi	Komposisi Campuran (%)		
				Curah	Semu		6,2	6,2	6,2
1/2 inch	12,7 mm	10	G1	2,374	2,483	P1	9,38	9,38	9,38
3/8 inch	9,52 mm	10	G2	2,458	2,576	P2	9,38	9,38	9,38
No. 4	4,76 mm	20	G3	2,713	2,843	P3	18,76	18,76	18,76
No. 8	2,38 mm	17,5	G4	2,538	2,647	P4	16,415	16,415	16,415
No. 30	0,59 mm	19	G5	2,486	2,596	P5	17,822	17,822	17,822
No. 50	0,297 mm	5,5	G6	2,472	2,58	P6	5,159	5,159	5,159
No. 100	0,149 mm	6	G7	2,521	2,623	P7	5,628	5,628	5,628
No. 200	0,074 mm	5	G8	2,501	2,604	P8	4,69	4,69	4,69
Pan		7	G9	2,680	2,680	P9	6,566	6,566	6,566
Total Agregat		100	Gs			Ps	93,8	93,8	93,8
Berat Jenis Curah (Gsb), Agregat Total							2,538	2,538	2,538
Berat Jenis Semu (Gsa), Agregat Total							2,644	2,644	2,644
Berat Jenis Efektif (Gse), Agregat Total							2,591	2,591	2,591
Berat Jenis Aspal (Gb)							1,03	1,03	1,03
Berat Jenis Maksimum (Gmm), Campuran							2,368	2,368	2,368
Berat Kering (Bk), (gram)							1210,5	1212,4	1216,4
Berat Kering Permukaan Jenuh (Bssd), (gram)							1220,2	1224,7	1223,9
Berat dalam Air (Ba), (gram)							683	690	689
Kepadatan (Gmb)							2,253	2,267	2,274
Kadar Aspal Terserap (Pba), (%)							0,83	0,83	0,83
Kadar Aspal Efektif (Pbe), (%)							5,42	5,42	5,42
Rongga dalam Mineral Agregat (VMA), (%)							16,7	16,2	15,9
Rongga dalam Campuran (VIM), (%)							4,8	4,3	4,0

Lampiran 7 Komposisi Campuran Beraspal Panas pada Kadar Aspal Optimum dengan Perendaman

Ukuran Material		% Tertahan Desain	Notasi	Berat Jenis (G)		Notasi	Komposisi Campuran (%)		
				Curah	Semu		6,2	6,2	6,2
1/2 inch	12,7 mm	10	G1	2,374	2,483	P1	9,38	9,38	9,38
3/8 inch	9,52 mm	10	G2	2,458	2,576	P2	9,38	9,38	9,38
No. 4	4,76 mm	20	G3	2,713	2,843	P3	18,76	18,76	18,76
No. 8	2,38 mm	17,5	G4	2,538	2,647	P4	16,415	16,415	16,415
No. 30	0,59 mm	19	G5	2,486	2,596	P5	17,822	17,822	17,822
No. 50	0,297 mm	5,5	G6	2,472	2,58	P6	5,159	5,159	5,159
No. 100	0,149 mm	6	G7	2,521	2,623	P7	5,628	5,628	5,628
No. 200	0,074 mm	5	G8	2,501	2,604	P8	4,69	4,69	4,69
Pan		7	G9	2,680	2,680	P9	6,566	6,566	6,566
Total Agregat		100	Gs			Ps	93,8	93,8	93,8
Berat Jenis Curah (Gsb), Agregat Total							2,538	2,538	2,538
Berat Jenis Semu (Gsa), Agregat Total							2,644	2,644	2,644
Berat Jenis Efektif (Gse), Agregat Total							2,591	2,591	2,591
Berat Jenis Aspal (Gb)							1,03	1,03	1,03
Berat Jenis Maksimum (Gmm), Campuran							2,368	2,368	2,368
Berat Kering (Bk), (gram)							1209,8	1211,8	1215,4
Berat Kering Permukaan Jenuh (Bssd), (gram)							1222,3	1224,1	1224,7
Berat dalam Air (Ba), (gram)							684	690	687
Kepadatan (Gmb)							2,247	2,269	2,260
Kadar Aspal Terserap (Pba), (%)							0,83	0,83	0,83
Kadar Aspal Efektif (Pbe), (%)							5,42	5,42	5,42
Rongga dalam Mineral Agregat (VMA), (%)							16,9	16,1	16,4
Rongga dalam Campuran (VIM), (%)							5,1	4,2	4,6

Lampiran 8 Hasil Pengujian Marshall dengan Perendaman pada Kadar Aspal Optimum

Umur Rendaman (Hari)	Nomor Benda Uji	Berat Benda Uji			Bulk Volume (ml)	Faktor Koreksi	Kepadatan (gr/ml)	VMA (%)	VIM (%)	Pembacaan Stabilitas	Stabilitas Marshall (kg)	Kelelehan (mm)	Marshall Quotient (kg/mm)
		Kering (gr)	Kering Permukaan Jenuh (gr)	Dalam Air (gr)									
0	1	1210,5	1220,2	683	537,2	0,93	2,253	16,7	4,8	87,0	949,1	3,1	306,2
	2	1212,4	1224,7	690	534,7	0,96	2,267	16,2	4,3	81,0	912,1	3,0	304,0
	3	1216,4	1223,9	689	534,9	0,96	2,274	15,9	4,0	85,0	957,2	3,2	299,1
Rata -rata							2,265	16,3	4,4	84,3	939,5	3,1	303,1
1	1	1209,8	1222,3	684	538,3	0,93	2,247	16,9	5,1	76,0	829,1	3,1	267,4
	2	1211,8	1224,1	690	534,1	0,96	2,269	16,1	4,2	71,0	799,5	3,2	249,8
	3	1215,4	1224,7	687	537,7	0,93	2,260	16,4	4,6	75,0	818,2	3,2	255,7
Rata -rata							2,259	16,5	4,6	74,0	815,6	3,2	257,6

Lampiran 9 Komposisi Campuran Beraspal Panas pada Kadar Aspal Optimum dengan Penambahan Gilsonite (Benda Uji 1)

Ukuran Material		% Tertahan Desain	Notasi	Berat Jenis (G)		Notasi	Penambahan Gilsonite (%)				
				Curah	Semu		0	4	8	10	12
1/2 inch	12,7 mm	10	G1	2,374	2,483	P1	9,38	9,38	9,38	9,38	9,38
3/8 inch	9,52 mm	10	G2	2,458	2,576	P2	9,38	9,38	9,38	9,38	9,38
No. 4	4,76 mm	20	G3	2,713	2,843	P3	18,76	18,76	18,76	18,76	18,76
No. 8	2,38 mm	17,5	G4	2,538	2,647	P4	16,415	16,415	16,415	16,415	16,415
No. 30	0,59 mm	19	G5	2,486	2,596	P5	17,822	17,822	17,822	17,822	17,822
No. 50	0,297 mm	5,5	G6	2,472	2,58	P6	5,159	5,159	5,159	5,159	5,159
No. 100	0,149 mm	6	G7	2,521	2,623	P7	5,628	5,628	5,628	5,628	5,628
No. 200	0,074 mm	5	G8	2,501	2,604	P8	4,69	4,69	4,69	4,69	4,69
Pan		7	G9	2,680	2,680	P9	6,566	6,566	6,566	6,566	6,566
Total Agregat		100	Gs			Ps	93,8	93,8	93,8	93,8	93,8
Berat Jenis Curah (Gsb), Agregat Total							2,538	2,538	2,538	2,538	2,538
Berat Jenis Semu (Gsa), Agregat Total							2,644	2,644	2,644	2,644	2,644
Berat Jenis Efektif (Gse), Agregat Total							2,591	2,591	2,591	2,591	2,591
Berat Jenis Aspal (Gb)							1,03	1,03	1,03	1,03	1,03
Berat Jenis Maksimum (Gmm), Campuran							2,368	2,368	2,368	2,368	2,368
Berat Kering (Bk), (gram)							1211,6	1208,2	1201,8	1210,9	1213,5
Berat Kering Permukaan Jenuh (Bssd), (gram)							1224,7	1220,5	1221,5	1225,0	1221,5
Berat dalam Air (Ba), (gram)							681	676	689	687	689
Kepadatan (Gmb)							2,228	2,219	2,257	2,251	2,279
Kadar Aspal Terserap (Pba), (%)							0,83	0,83	0,83	0,83	0,83
Kadar Aspal Efektif (Pbe), (%)							5,42	5,42	5,42	5,42	5,42
Rongga dalam Mineral Agregat (VMA), (%)							17,6	18,0	16,6	16,8	15,8
Rongga dalam Campuran (VIM), (%)							5,9	6,3	4,7	5,0	3,8

Lampiran 10 Komposisi Campuran Beraspal Panas pada Kadar Aspal Optimum dengan Penambahan Gilsonite (Benda Uji 2)

Ukuran Material		% Tertahan Desain	Notasi	Berat Jenis (G)		Notasi	Penambahan Gilsonite (%)				
				Curah	Semu		0	4	8	10	12
1/2 inch	12,7 mm	10	G1	2,374	2,483	P1	9,38	9,38	9,38	9,38	9,38
3/8 inch	9,52 mm	10	G2	2,458	2,576	P2	9,38	9,38	9,38	9,38	9,38
No. 4	4,76 mm	20	G3	2,713	2,843	P3	18,76	18,76	18,76	18,76	18,76
No. 8	2,38 mm	17,5	G4	2,538	2,647	P4	16,415	16,415	16,415	16,415	16,415
No. 30	0,59 mm	19	G5	2,486	2,596	P5	17,822	17,822	17,822	17,822	17,822
No. 50	0,297 mm	5,5	G6	2,472	2,58	P6	5,159	5,159	5,159	5,159	5,159
No. 100	0,149 mm	6	G7	2,521	2,623	P7	5,628	5,628	5,628	5,628	5,628
No. 200	0,074 mm	5	G8	2,501	2,604	P8	4,69	4,69	4,69	4,69	4,69
Pan		7	G9	2,680	2,680	P9	6,566	6,566	6,566	6,566	6,566
Total Agregat		100	Gs			Ps	93,8	93,8	93,8	93,8	93,8
Berat Jenis Curah (Gsb), Agregat Total							2,538	2,538	2,538	2,538	2,538
Berat Jenis Semu (Gsa), Agregat Total							2,644	2,644	2,644	2,644	2,644
Berat Jenis Efektif (Gse), Agregat Total							2,591	2,591	2,591	2,591	2,591
Berat Jenis Aspal (Gb)							1,03	1,03	1,03	1,03	1,03
Berat Jenis Maksimum (Gmm), Campuran							2,368	2,368	2,368	2,368	2,368
Berat Kering (Bk), (gram)							1210,8	1210,4	1210,4	1211,3	1215,6
Berat Kering Permukaan Jenuh (Bssd), (gram)							1224,8	1220,8	1224,3	1222,6	1223,7
Berat dalam Air (Ba), (gram)							678	678	691	690	691
Kepadatan (Gmb)							2,214	2,230	2,270	2,274	2,282
Kadar Aspal Terserap (Pba), (%)							0,83	0,83	0,83	0,83	0,83
Kadar Aspal Efektif (Pbe), (%)							5,42	5,42	5,42	5,42	5,42
Rongga dalam Mineral Agregat (VMA), (%)							18,2	17,6	16,1	15,9	15,7
Rongga dalam Campuran (VIM), (%)							6,5	5,8	4,2	4,0	3,6

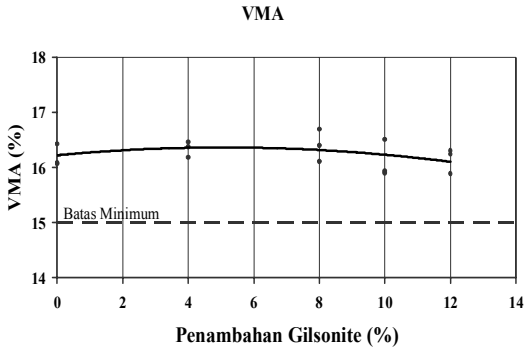
Lampiran 11 Komposisi Campuran Beraspal Panas pada Kadar Aspal Optimum dengan Penambahan Gilsonite (Benda Uji 3)

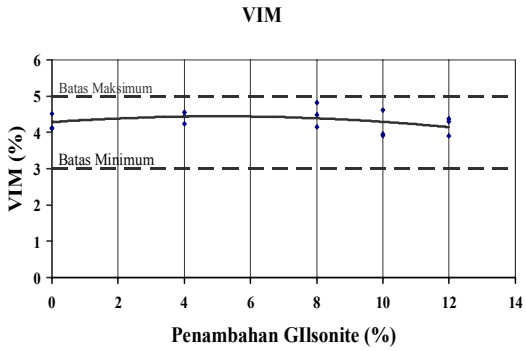
Ukuran Material		% Tertahan Desain	Notasi	Berat Jenis (G)		Notasi	Penambahan Gilsonite (%)				
				Curah	Semu		0	4	8	10	12
1/2 inch	12,7 mm	10	G1	2,374	2,483	P1	9,38	9,38	9,38	9,38	9,38
3/8 inch	9,52 mm	10	G2	2,458	2,576	P2	9,38	9,38	9,38	9,38	9,38
No. 4	4,76 mm	20	G3	2,713	2,843	P3	18,76	18,76	18,76	18,76	18,76
No. 8	2,38 mm	17,5	G4	2,538	2,647	P4	16,415	16,415	16,415	16,415	16,415
No. 30	0,59 mm	19	G5	2,486	2,596	P5	17,822	17,822	17,822	17,822	17,822
No. 50	0,297 mm	5,5	G6	2,472	2,58	P6	5,159	5,159	5,159	5,159	5,159
No. 100	0,149 mm	6	G7	2,521	2,623	P7	5,628	5,628	5,628	5,628	5,628
No. 200	0,074 mm	5	G8	2,501	2,604	P8	4,69	4,69	4,69	4,69	4,69
Pan		7	G9	2,680	2,680	P9	6,566	6,566	6,566	6,566	6,566
Total Agregat		100	Gs			Ps	93,8	93,8	93,8	93,8	93,8
Berat Jenis Curah (Gsb), Agregat Total							2,538	2,538	2,538	2,538	2,538
Berat Jenis Semu (Gsa), Agregat Total							2,644	2,644	2,644	2,644	2,644
Berat Jenis Efektif (Gse), Agregat Total							2,591	2,591	2,591	2,591	2,591
Berat Jenis Aspal (Gb)							1,03	1,03	1,03	1,03	1,03
Berat Jenis Maksimum (Gmm), Campuran							2,368	2,368	2,368	2,368	2,368
Berat Kering (Bk), (gram)							1215,7	1209,3	1213,4	1220,1	1219,8
Berat Kering Permukaan Jenuh (Bssd), (gram)							1220,4	1219,5	1223,5	1228,4	1224,6
Berat dalam Air (Ba), (gram)							673	678	687	691	693
Kepadatan (Gmb)							2,221	2,233	2,262	2,270	2,295
Kadar Aspal Terserap (Pba), (%)							0,83	0,83	0,83	0,83	0,83
Kadar Aspal Efektif (Pbe), (%)							5,42	5,42	5,42	5,42	5,42
Rongga dalam Mineral Agregat (VMA), (%)							17,9	17,5	16,4	16,1	15,2
Rongga dalam Campuran (VIM), (%)							6,2	5,7	4,5	4,1	3,1

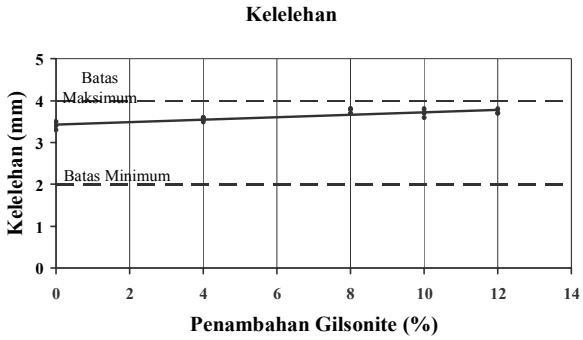
Lampiran 12 Hasil Pengujian Marshall Campuran Beraspal Panas pada Kadar Aspal Optimum dengan Penambahan Gilsonite

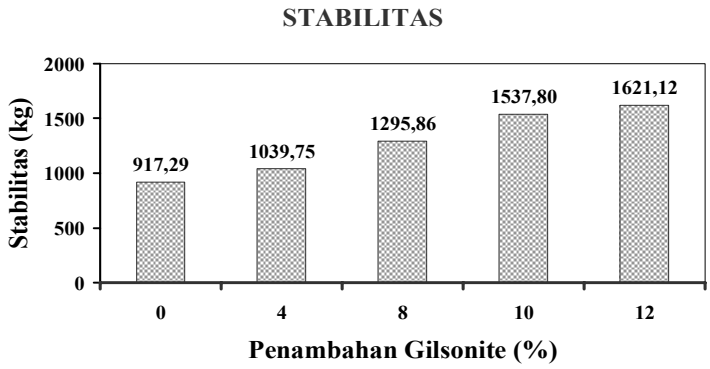
Kadar Aspal (%)	Kadar Gilsonite (%)	Nomor Benda Uji	Berat Benda Uji			Bulk Volume (ml)	Faktor Koreksi	Kepadatan (gr/ml)	VMA (%)	VIM (%)	Pembacaan Stabilitas	Stabilitas Marshall (kg)	Kelelehan (mm)	Marshall Quotient (kg/mm)
			Kering (gr)	Kering Permukaan Jenuh (gr)	Dalam Air (gr)									
6,2	0	1	1211,9	1218,7	685	533,7	0,96	2,271	16,1	4,1	78,0	878,3	3,3	266,2
6,2	0	2	1209,6	1224,8	692	532,8	0,96	2,270	16,1	4,1	85,0	957,2	3,5	273,5
6,2	0	3	1214,4	1224,1	687	537,1	0,93	2,261	16,4	4,5	84,0	916,3	3,4	269,5
Rata -rata								2,267	16,2	4,3	82,3	917,3	3,4	269,8
6,2	4	1	1209,8	1220,3	685	535,3	0,96	2,260	16,5	4,6	91,0	1024,7	3,5	292,8
6,2	4	2	1210,4	1220,8	687	533,8	0,96	2,268	16,2	4,2	94,0	1058,5	3,6	294,0
6,2	4	3	1209,3	1219,5	685	534,5	0,96	2,262	16,4	4,5	92,0	1036,0	3,6	287,8
Rata -rata								2,263	16,3	4,4	92,3	1039,7	3,6	291,5
6,2	8	1	1211,4	1221,5	684	537,5	0,93	2,254	16,7	4,8	118,0	1287,3	3,7	347,9
6,2	8	2	1210,4	1224,3	691	533,3	0,96	2,270	16,1	4,2	116,8	1315,3	3,8	346,1
6,2	8	3	1213,4	1223,5	687	536,5	0,93	2,262	16,4	4,5	117,8	1285,1	3,8	338,2
Rata -rata								2,262	16,4	4,5	117,5	1295,9	3,8	344,0
6,2	10	1	1211,8	1223,5	687	536,5	0,93	2,259	16,5	4,6	138,0	1505,4	3,6	418,2
6,2	10	2	1211,3	1222,6	690	532,6	0,96	2,274	15,9	4,0	135,6	1527,0	3,7	412,7
6,2	10	3	1216,6	1225,7	691	534,7	0,96	2,275	15,9	3,9	140,4	1581,0	3,8	416,1
Rata -rata								2,269	16,1	4,2	138,0	1537,8	3,7	415,6
6,2	12	1	1213,5	1224,5	689	535,5	0,93	2,266	16,2	4,3	144,5	1576,3	3,7	426,0
6,2	12	2	1212,2	1223,7	691	532,7	0,96	2,276	15,9	3,9	147,3	1658,7	3,7	448,3
6,2	12	3	1210,5	1224,6	690	534,6	0,96	2,264	16,3	4,4	144,6	1628,3	3,8	428,5
Rata -rata								2,269	16,1	4,2	1621,1	1621,1	3,7	434,3

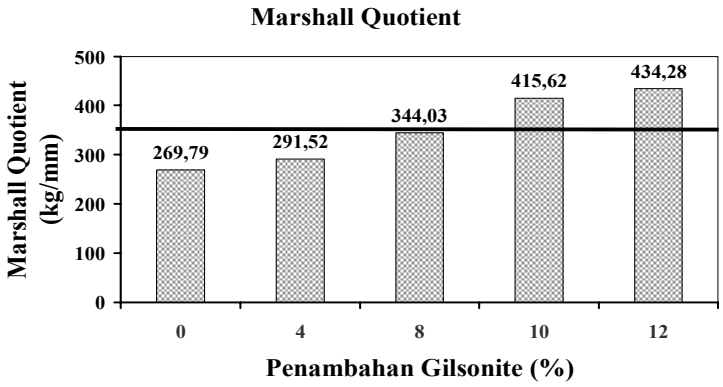
Lampiran 13 Hubungan Parameter Marshall dengan Penambahan Gilsonite











Lampiran 14 Hasil Pengujian Marshall dengan Perendaman terhadap Campuran Beraspal Panas dengan Penambahan Gilsonite 4%

Umur Rendaman (Hari)	Nomor Benda Uji	Berat Benda Uji			Bulk Volume (ml)	Faktor Koreksi	Kepadatan (gr/ml)	VMA (%)	VIM (%)	Pembacaan Stabilitas	Stabilitas Marshall (kg)	Kelelehan (mm)	Marshall Quotient (kg/mm)
		Kering (gr)	Kering Permukaan Jenuh (gr)	Dalam Air (gr)									
0	1	1209,8	1220,3	685	535,3	0,96	2,253	16,7	4,8	91,0	1024,7	3,5	292,8
	2	1210,4	1220,8	687	533,8	0,96	2,267	16,2	4,3	94,0	1058,5	3,6	294,0
	3	1209,3	1219,5	685	534,5	0,96	2,274	15,9	4,0	92,0	1036,0	3,6	287,8
Rata -rata							2,265	16,3	4,4	92,3	1039,7	3,6	291,5
1	1	1212,5	1219,0	684	535,0	0,96	2,247	16,9	5,1	83,4	939,2	3,1	303,0
	2	1210,4	1224,3	691	533,3	0,96	2,269	16,1	4,2	82,4	927,9	3,2	290,0
	3	1214,5	1224,6	687	537,6	0,93	2,260	16,4	4,6	84,6	922,9	3,2	288,4
Rata -rata							2,259	16,5	4,6	83,5	930,0	3,2	293,7

Lampiran 15 Hasil Pengujian Marshall dengan Perendaman terhadap Campuran Beraspal Panas dengan Penambahan Gilsonite 8%

Umur Rendaman (Hari)	Nomor Benda Uji	Berat Benda Uji			Bulk Volume (ml)	Faktor Koreksi	Kepadatan (gr/ml)	VMA (%)	VIM (%)	Pembacaan Stabilitas	Stabilitas Marshall (kg)	Kelelehan (mm)	Marshall Quotient (kg/mm)
		Kering (gr)	Kering Permukaan Jenuh (gr)	Dalam Air (gr)									
0	1	1211,4	1221,5	684	537,5	0,93	2,253	16,7	4,8	118,0	1287,3	3,7	347,9
	2	1210,4	1224,3	691	533,3	0,96	2,267	16,2	4,3	116,8	1315,3	3,8	346,1
	3	1213,4	1223,5	687	536,5	0,93	2,274	15,9	4,0	117,8	1285,1	3,8	338,2
Rata -rata							2,265	16,3	4,4	117,5	1295,9	3,8	344,0
1	1	1211,8	1223,5	687	536,5	0,93	2,247	16,9	5,1	107,5	1172,7	3,4	344,9
	2	1211,3	1222,6	690	532,6	0,96	2,269	16,1	4,2	110,3	1242,1	3,3	376,4
	3	1216,6	1225,7	691	534,7	0,96	2,260	16,4	4,6	109,6	1234,2	3,6	342,8
Rata -rata							2,259	16,5	4,6	109,1	1216,3	3,4	354,3

Lampiran 16 Contoh Perhitungan Komposisi Campuran Marshall

1. **Komposisi Campuran terhadap Berat Total Campuran (P)**

Berat agregat = 1150 gr

% aspal = 5%

% agregat = 95%

Berat campuran = 1150/0,95 = 1210,53 gr

Berat aspal = 1210,53 – 1150 = 60,53 gr

Berat agregat tiap saringan = % tertahan x Berat agregat

Berat agregat tertahan saringan ½ inch = 10% x 1150 = 115 gr

Berat agregat lolos ½ inch tertahan 3/8 inch = 10% x 1150 = 115 gr

Berat agregat lolos 3/8 inch tertahan no.4 = 20% x 1150 = 230 gr

Berat agregat lolos no. 4 tertahan no.8 = 17,5% x 1150 = 201,25 gr

Berat agregat lolos no. 8 tertahan no.30 = 19% x 1150 = 218,5 gr

Berat agregat lolos no. 30 tertahan no.50 = 5,5% x 1150 = 63,25 gr

Berat agregat lolos no. 50 tertahan no.100 = 6% x 1150 = 69 gr

Berat agregat lolos no. 100 tertahan no.200 = 5% x 1150 = 57,5 gr

Berat agregat lolos no. 200 tertahan Pan = 7% x 1150 = 80,5 gr

P_1 = (115/1210,53) x 100% = 9,5 %

P_2 = (115/1210,53) x 100% = 9,5 %

P_3 = (230/1210,53) x 100% = 19 %

P_4 = (201,25/1210,53) x 100% = 16,625 %

P_5 = (218,5/1210,53) x 100% = 18,05 %

P_6 = (63,25/1210,53) x 100% = 5,225 %

P_7 = (69/1210,53) x 100% = 5,7 %

P_8 = (57,5/1210,53) x 100% = 4,75 %

P_9 = (80,5/1210,53) x 100% = 6,65 %

2. Berat Jenis Curah (Gsb)

$$G_{sb} = \frac{P_1 + P_2 + \ldots + P_n}{\frac{P_1}{G_{sb1}} + \frac{P_2}{G_{sb2}} + \ldots + \frac{P_n}{G_{sbn}}}$$

dengan :

$P_1, P_2, \ldots, P_n$ = Persen berat agregat ke-1, 2, dan ke-n terhadap berat total campuran.

$G_{sb1}, G_{sb2}, \ldots, G_{sbn}$ = Bulk Specific Gravity agregat ke-1, 2, dan ke-n.

$$G_{sb} = \frac{9,5 + 9,5 + 19 + 16,625 + 18,05 + 5,225 + 5,7 + 4,75 + 6,65}{\frac{9,5}{2,374} + \frac{9,5}{2,458} + \frac{19}{2,713} + \frac{16,225}{2,538} + \frac{18,05}{2,486} + \frac{5,225}{2,472} + \frac{5,7}{2,521} + \frac{4,75}{2,501} + \frac{6,65}{2,68}}$$

= 2,538

3. Berat Jenis Semu (Gsa)

$$G_{sa} = \frac{P_1 + P_2 + \ldots + P_n}{\frac{P_i}{G_{ap1}} + \frac{P_2}{G_{ap2}} + \ldots + \frac{P_n}{G_{apn}}}$$

dengan :

$P_1, P_2, \ldots, P_n$ = Persen berat agregat ke-1, 2, dan ke-n terhadap berat total campuran.

$G_{sa1}, G_{sa2}, \ldots, G_{san}$ = Apparent Specific Gravity agregat ke-1, 2, dan ke-n.

$$G_{sa} = \frac{9,5+9,5+19+16,625+18,05+5,225+5,7+4,75+6,65}{\frac{9,5}{2,483}+\frac{9,5}{2,576}+\frac{19}{2,843}+\frac{16,625}{2,647}+\frac{18,05}{2,596}+\frac{5,225}{2,58}+\frac{5,7}{2,623}+\frac{4,75}{2,604}+\frac{6,65}{2,68}}$$

$G_{sa} = 2,644$

4. Berat Jenis Efektif (Gse)

$$Gse = \frac{Gsb + Gsa}{2}$$

dengan :

Gsb = Berat jenis curah agregat

Gsa = Berat jenis semu agregat

$$Gse = \frac{2,538 + 2,644}{2} = 2,591$$

5. Berat Jenis Maksimum (Gmm)

$$Gmm = \frac{Pmm}{\frac{Ps}{Gse}+\frac{Pb}{Gb}}$$

dengan : Pmm = 100%

Ps = Total persen agregat terhadap berat total campuran

Pb = Persen aspal terhadap berat total campuran

Gse = Berat jenis efektif agregat

Gb = Berat jenis aspal

$$Gmm = \frac{100}{\frac{95}{2,591}+\frac{5}{1,03}} = 2,408$$

6. Kepadatan (Gmb)

Berat kering = 1195,0 gr

Berat kering permukaan jenuh = 1206,0 gr

Berat dalam air = 669 gr

γ_{air} = 1 gr/cm^3

Bulk Volume = (Berat kering permukaan jenuh – Berat dalam air) / γ_{air}

= (1206 – 669) / 1

= 537 cm^3 = 537 ml

$$\text{Gmb} = \text{Kepadatan} = \frac{Berat\,\text{ker}\,ing}{Bulkvolume}$$

$$= \frac{1195}{537} = 2.225 \text{ gr/ml}$$

7. Kadar Aspal Terserap (Pba)

$$\text{Pba} = 100 \text{ x } \frac{Gse - Gsb}{GsexGsb} \text{ Gb}$$

$$= 100 \text{ x } \frac{2{,}591 - 2{,}538}{2{,}591x2{,}538} \text{ x } 1{,}03$$

Pba = 0,83 %

8. Kadar Aspal Efektif (Pbe)

$$\text{Pbe} = P_b - \frac{P_{ba}}{100} \times P_s$$

$$= 5 - \left(\frac{0{,}83}{100}\right) \text{ x } 95$$

Pbe = 4,21 %

9. Rongga dalam Mineral Agregat (VMA)

$$VMA = 100 - \frac{G_{mb} \times P_s}{G_{sb}}$$

$$= 100 - \frac{2,225x95}{2,538}$$

= 16,7 %

10. Rongga dalam Campuran (VIM)

$$VIM = 100 \text{ x } \frac{Gmm - Gmb}{Gmm}$$

$$= 100 \text{ x } \frac{2,408 - 2,225}{2,408}$$

= 7,6 %

11. Stabilitas Marshall

Pembacaan arloji stabilitas (dial) = 68 div

Kalibrasi proving ring = 25,882 lbf

Faktor Koreksi = 0,93

1 kg = 2,205 lbf

Stabilitas Marshall = Dial x kalibrasi x factor koreksi

= 68 x 25,882 x 0,93

= 1636,778 lbf

= 1636,778 / 2.205

Stabilitas Marshall = 741,8 kg

12. Marshall Quotient

Kelelehan = 2,9 mm

Stabilitas Marshall = 741,8 kg

$$\text{Marshall Quotient} = \frac{StabilitasMarshall}{Kelelehan}$$

$$\text{Marshall Quotient} = \frac{741.8}{2.9} = 255{,}8 \text{ kg/mm}$$

Lampiran 17 Data dan Hasil Pengujian ANOVA Aspal Penetrasi 60

1. Pengujian Penetrasi

Benda Uji	Penetrasi (mm)				
	Penambahan gilsonite (%)				
	0	4	8	10	12
1	63	58	45	37	33
2	63	56	45	39	33
Rata-rata	63	57	45	38	33

Groups	*Count*	*Sum*	*Average*	*Variance*
0	2	126	63	0
4	2	113	56,5	0,5
8	2	90	45	0
10	2	76	38	0
12	2	66	33	0

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	1254,4	4	313,6	3136	1,109E-08	5,1921678
Within Groups	0,5	5	0,1			
Total	1254,9	9				

2. Pengujian Titik Lembek

Benda Uji	Titik Lembek (°C)				
	Penambahan gilsonite (%)				
	0	4	8	10	12
1	48	51	55	55	58
2	50	51	53	57	60
Rata-rata	49	51	54	56	59

Groups	*Count*	*Sum*	*Average*	*Variance*
0	2	98	49	2
4	2	102	51	0
8	2	108	54	2
10	2	112	56	2
12	2	118	59	2

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	125,6	4	31,4	19,625	0,0029396	5,1921678
Within Groups	8	5	1,6			
Total	133,6	9				

3. Pengujian Viskositas 170 cst (Temperatur Campuran)

Benda Uji	Viskositas (170 cst)				
	Penambahan gilsonite (%)				
	0	4	8	10	12
1	150	172	171	172	179
2	152	170	173	176	177
Rata-rata	151	171	172	174	178

Groups	*Count*	*Sum*	*Average*	*Variance*
0	2	302	151	2
4	2	342	171	2
8	2	344	172	2
10	2	348	174	8
12	2	356	178	2

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	885,6	4	221,4	69,1875	0,000145	5,1921678
Within Groups	16	5	3,2			
Total	901,6	9				

4. Pengujian Viskositas 280 cst (Temperatur Pemadatan)

Benda Uji	Viskositas (280 cst)				
	Penambahan gilsonite (%)				
	0	4	8	10	12
1	137	152	159	162	166
2	139	150	155	160	164
Rata-rata	138	151	157	161	165

Groups	*Count*	*Sum*	*Average*	*Variance*
0	2	276	138	2
4	2	302	151	2
8	2	314	157	8
10	2	322	161	2
12	2	330	165	2

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	886,4	4	221,6	69,25	0,0001447	5,1921678
Within Groups	16	5	3,2			
Total	902,4	9				

Lampiran 18 Data dan Hasil Pengujian ANOVA Campuran Beraspal Panas

1. Pengujian VMA

VMA (%)			
Benda Uji	Penambahan Gilsonite (%)		
	0	4	8
1	16,1	16,5	16,7
2	16,1	16,2	16,1
3	16,4	16,4	16,4

Groups	*Count*	*Sum*	*Average*	*Variance*
0	3	48,572956	16,190985	0,0410032
4	3	49,016804	16,338935	0,0198429
8	3	49,199398	16,399799	0,0860755

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	0,0691968	2	0,0345984	0,7064664	0,5302535	5,1432528
Within Groups	0,293843	6	0,0489738			
Total	0,3630398	8				

2. Pengujian VIM

VIM (%)			
Benda Uji	Penambahan Gilsonite (%)		
	0	4	8
1	4,1	4,6	4,8
2	4,1	4,2	4,2
3	4,5	4,5	4,5

Groups	*Count*	*Sum*	*Average*	*Variance*
0	3	12,751136	4,2503787	0,0535193
4	3	13,258221	4,419407	0,0258998
8	3	13,46683	4,4889432	0,1123497

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	0,0903188	2	0,0451594	0,7064664	0,5302535	5,1432528
Within Groups	0,3835377	6	0,063923			
Total	0,4738566	8				

3. Pengujian Stabilitas

Stabilitas (kg)			
Benda Uji	Penambahan Gilsonite (%)		
	0	4	8
1	878,3	1024,7	1287,3
2	957,2	1058,5	1315,3
3	916,3	1036,0	1285,1

Groups	*Count*	*Sum*	*Average*	*Variance*
0	3	2751,858	917,286	1554,0292
4	3	3119,2416	1039,7472	295,87977
8	3	3887,5801	1295,86	283,50136

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	223908,81	2	111954,41	157,4302	6,539E-06	5,1432528
Within Groups	4266,8208	6	711,1368			
Total	228175,63	8				

4. Pengujian Marshall Quotient

Marshall Quotient (kg/mm)			
Benda Uji	Penambahan Gilsonite (%)		
	0	4	8
1	266,2	292,8	347,9
2	273,5	294,0	346,1
3	269,5	287,8	338,2

Groups	*Count*	*Sum*	*Average*	*Variance*
0	3	809,15494	269,71831	13,398403
4	3	874,5888	291,5296	10,95851
8	3	1032,2028	344,0676	26,829759

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	8763,7897	2	4381,8948	256,8185	1,539E-06	5,1432528
Within Groups	102,37334	6	17,062224			
Total	8866,163	8				

5. Pengujian Indeks Perendaman

Indeks Perendaman			
Benda Uji	Penambahan Gilsonite (%)		
	0	4	8
1	87,4	91,6	91,1
2	87,7	87,7	94,4
3	85,5	89,1	96,0

Groups	*Count*	*Sum*	*Average*	*Variance*
0	3	260,48858	86,829528	1,3922911
4	3	268,39081	89,463602	4,0862976
8	3	281,57694	93,858978	6,3462684

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	75,670853	2	37,835426	9,5989556	0,0135008	5,1432528
Within Groups	23,649714	6	3,9416191			
Total	99,320567	8				

Lampiran 19 Data dan Hasil Uji-t

1. Uji-t Stabilitas

Stabilitas (kg)			
Benda Uji	Penambahan Gilsonite (%)		
	0	4	8
1	878,3	1024,7	1287,3
2	957,2	1058,5	1315,3
3	916,3	1036,0	1285,1

	0%	*4%*
Mean	917,286	1039,7472
Variance	1554,0292	295,87977
Observations	3	3
Pearson Correlation	0,985667738	
Hypothesized Mean Difference	0	
df	2	
t Stat	-9,363322844	
P(T<=t) one-tail	0,00560733	
t Critical one-tail	2,91998558	
P(T<=t) two-tail	0,01121466	
t Critical two-tail	4,30265273	

	0%	*8%*
Mean	917,286	1295,86
Variance	1554,0292	283,50136
Observations	3	3
Pearson Correlation	0,843077108	
Hypothesized Mean Difference	0	
df	2	
t Stat	-24,46508471	
P(T<=t) one-tail	0,000833278	
t Critical one-tail	2,91998558	
P(T<=t) two-tail	0,001666556	
t Critical two-tail	4,30265273	

	4%	8%
Mean	1039,7472	1295,86
Variance	295,87977	283,50136
Observations	3	3
Pearson Correlation	0,92171861	
Hypothesized Mean Difference	0	
df	2	
t Stat	-65,78057861	
P(T<=t) one-tail	0,000115511	
t Critical one-tail	2,91998558	
P(T<=t) two-tail	0,000231022	
t Critical two-tail	4,30265273	

2. Uji-t Marshall Quotient

Marshall Quotient (kg/mm)			
Benda Uji	Penambahan Gilsonite (%)		
	0	4	8
1	266,2	292,8	347,9
2	273,5	294,0	346,1
3	269,5	287,8	338,2

	0%	4%
Mean	269,71831	291,5296
Variance	13,398403	10,95851
Observations	3	3
Pearson Correlation	0,236229233	
Hypothesized Mean Difference	0	
df	2	
t Stat	-8,75208945	
P(T<=t) one-tail	0,006402389	
t Critical one-tail	2,91998558	
P(T<=t) two-tail	0,012804778	
t Critical two-tail	4,30265273	

	0%	8%
Mean	269,71831	344,0676
Variance	13,398403	26,829759
Observations	3	3
Pearson Correlation	-0,124393846	
Hypothesized Mean Difference	0	
df	2	
t Stat	-19,20861527	
P(T<=t) one-tail	0,001349636	
t Critical one-tail	2,91998558	
P(T<=t) two-tail	0,002699272	
t Critical two-tail	4,30265273	

	4%	8%
Mean	291,5296	344,0676
Variance	10,95851	26,829759
Observations	3	3
Pearson Correlation	0,934764643	
Hypothesized Mean Difference	0	
df	2	
t Stat	-38,00936928	
P(T<=t) one-tail	0,000345731	
t Critical one-tail	2,91998558	
P(T<=t) two-tail	0,000691462	
t Critical two-tail	4,30265273	

3. Uji-t Indeks Perendaman

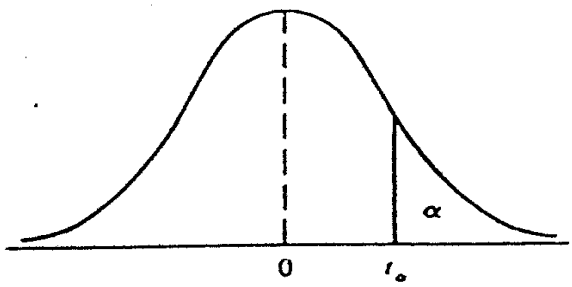
Indeks Perendaman			
Benda Uji	Penambahan Gilsonite (%)		
	0	4	8
1	87,4	91,6	91,1
2	87,7	87,7	94,4
3	85,5	89,1	96,0

	0%	*4%*
Mean	86,829528	89,463602
Variance	1,3922911	4,0862976
Observations	3	3
Pearson Correlation	0,037216903	
Hypothesized Mean Difference	0	
df	2	
t Stat	-1,981562609	
P(T<=t) one-tail	0,093017863	
t Critical one-tail	2,91998558	
P(T<=t) two-tail	0,186035727	
t Critical two-tail	4,30265273	

	0%	*8%*
Mean	86,829528	93,858978
Variance	1,3922911	6,3462684
Observations	3	3
Pearson Correlation	-0,66033876	
Hypothesized Mean Difference	0	
df	2	
t Stat	-3,564944344	
P(T<=t) one-tail	0,035234673	
t Critical one-tail	2,91998558	
P(T<=t) two-tail	0,070469346	
t Critical two-tail	4,30265273	

	4%	*8%*
Mean	89,463602	93,858978
Variance	4,0862976	6,3462684
Observations	3	3
Pearson Correlation	-0,775023358	
Hypothesized Mean Difference	0	
df	2	
t Stat	-1,778370279	
P(T<=t) one-tail	0,108656683	
t Critical one-tail	2,91998558	
P(T<=t) two-tail	0,217313366	
t Critical two-tail	4,30265273	

Lampiran 20 Tabel Distribusi t



Nilai kritis distribusi *t*

	α				
ν	0,10	0,05	0,025	0.01	0,005
1	3,078	6,314	12,706	31,821	63,657
2	1,886	2,920	4,303	6,965	9,925
3	1,638	2,353	3,182	4,541	5,841
4	1,533	2,132	2,776	3,747	4,604
5	1,476	2,015	2,571	3,365	4,032
6	1,440	1,943	2,447	3,143	3,707
7	1,415	1,895	2,365	2,998	3,499
8	1,397	1,860	2,306	2,896	3,355
9	1,383	1,833	2,262	2,821	3,250
10	1,372	1,812	2,228	2,764	3,169
11	1,363	1,796	2,201	2,718	3,106
12	1,356	1,782	2,179	2,681	3,055
13	1,350	1,771	2,160	2,650	3,012
14	1,345	1,761	2,145	2,624	2,977
15	1,341	1,753	2,131	2,602	2,947
16	1,337	1,746	2,120	2,583	2,921
17	1,333	1,740	2,110	2,567	2,898
18	1,330	1,734	2,101	2,552	2,878
19	1,328	1,729	2,093	2,539	2,861
20	1,325	1,725	2,086	2,528	2,845
21	1,323	1,721	2,080	2,518	2,831
22	1,321	1,717	2,074	2,508	2,819
23	1,319	1,714	2,069	2,500	2,807
24	1,318	1,711	2,064	2,492	2,797
25	1,316	1,708	2,060	2,485	2,787
26	1,315	1,706	2,056	2,479	2,779
27	1,314	1,703	2,052	2,473	2,771
28	1,313	1,701	2,048	2,467	2,763
29	1,311	1,699	2,045	2,462	2,756
inf.	1,282	1,645	1,960	2,326	2,576

Lampiran 21 Tabel Koreksi Benda Uji

Isi Benda Uji (cm^3)	Tinggi Benda Uji		Angka Korelasi
	Inchi	mm	
200 – 213	1	25.4	5.56
214 – 225	1 1/16	27.0	5.00
226 – 237	1 1/8	28.6	4.55
238 – 250	1 3/16	30.2	4.17
252– 264	1 ¼	31.8	3.86
265 – 276	1 5/16	33.3	3.57
277 – 289	1 3/8	34.9	3.33
290 – 301	1 7/16	36.5	3.03
302 – 316	1 ½	38.1	2.78
317 – 328	1 9/16	39.7	2.50
329 – 340	1 5/8	41.3	2.27
342– 353	1 11/16	42.9	2.08
354 – 367	1 ¾	44.4	1.92
368 – 379	1 13/16	46.0	1.79
380 – 392	1 7/8	47.6	1.67
393 – 405	1 15/16	49.2	1.56
406 – 420	2	50.8	1.47
422– 431	2 1/16	52.4	1.39
432 – 443	2 1/8	54.0	1.32
444 – 456	2 3/16	55.6	1.25
457 – 470	2 ¼	57.2	1.19
472– 482	2 5/16	58.7	1.14
483 – 495	2 3/8	60.3	1.09
496 – 508	2 7/16	61.9	1.04
509 – 522	2 ½	63.5	1.00
523 – 535	2 9/16	64.0	0.96
536 – 546	2 5/8	65.1	0.93
547 – 559	2 11/16	66.7	0.89
560 – 573	2 ¾	68.3	0.86
574 – 585	2 13/16	71.4	0.83
586 – 598	2 7/8	73.0	0.81
599 – 610	2 15/16	74.6	0.78
612- 625	3	76.2	0.76