CHAPTER II

LITERATURE REVIEW

2.1 Pavement Mix Design

Asphalt pavement is combination of mineral aggregate material and asphaltic material constructed in various thickness and type (Hugh and Martin, 1967). Construction of Asphalt Pavement thickness is based on the wheel loads of the vehicle. The Construction of road pavement design consists of several layers such as sub grade layers, sub base layers, base layers, and surface.

Sukirman said (1992) that roads pavement design based on the bonding material that is classified into:

1. Flexible Pavement

   This pavement design uses asphalt as the bonding material. The objective of flexible pavement is to resist and distribute the load to the sub grade layer.

2. Rigid Pavement

   This pavement design uses Portland Cement (PC) as binder. Concrete slab is placed above the soil with or without reinforcement. In some cases, sub base layers were unused in this type of pavement.

3. Composite Pavement

   This pavement design is combination between flexible and rigid pavement design.

2.2 Asphalt

Asphalt which has functioned as bonding material has solid or semisolid form with the black or brown color. Asphalt also has thermoplastic characteristic, when asphalt get high temperature it should be melt, and it should be return to the original form at normal temperature, (Kerbs and Walker, 1971).

The classifications of asphaltic materials for use in paving are consistency, durability, or resistance to weathering, rate of curing, and resistance to the water action. There are two types of asphalt, namely native asphalt and petroleum asphalt, (Hugh and Martin, 1967).

Asphalt is supposed to have stiffness, high workability, enough tensile strength, good adhesion, and the good durability to the weather. These requirements are needed so when asphalt is added on to the pavement, it should resist the cracking, stripping, and other deformation, (Totomihardjo, 2004).

Type of asphalt based on form in the normal temperature into three types:

1. Asphalt Cement (AC).

   It has solid form in the normal room temperature,then to use it, we need to heat it.. The solid temperature of the asphalt is between 25^0C - 30^0C. In Indonesia the common type of AC are:

   a. AC 40/50 (penetration values between 40 – 59 mm)
   b. AC 60/70 (penetration values between 60 – 79 mm)
   c. AC 80/100 (penetration values between 80 – 99 mm)
   d. AC 120/150 (penetration values between 120 – 150 mm)
   e. AC 200/300 (penetration values between 200 – 300 mm)

2. Cutback Asphalt.

In shape of this asphalt was a liquid form at room or normal temperature. Cutback Asphalt is AC melted by using another petroleum substance. There is several type of Cutback Asphalt based on the petroleum substance:

a. Rapid Curing Cutback Asphalt (RC)

   This type use gasoline in the melting process.

b. Medium Curing Cutback Asphalt (MC)

   This type use kerosene in the melting process.

c. Slow Curing Cutback Asphalt (SC)

   This type use diesel oil in the melting process.

3. Emulsified Asphalt.

   This type of asphalt uses water and emulsion substance that mixedwith plant. This asphalt is more aqueous than Cutback Asphalt, (Sukirman, 1992)

2.3 Aggregate and Filler

Beside asphalt, there is material that important such as aggregate. This material is identified by measuring it size into course aggregate, fine aggregate, and filler, (Suryadharma etal, 1999)

Asphalt pavement consists of 90% - 95% of aggregate in weight or between 75% - 85% of volume. Characteristics of aggregate are size and gradation, strength and stiffness, surface texture, viscosity to the asphalt, hygiene and chemical content, (Kerbs and Walker, 1971).

Based on the size of the particle aggregate divide into:

a. Rough Aggregate

This aggregate has the minimum particle size that is not passes the sieve no.8 (2.36 mm). Rough aggregate consist of crushed stone or gravel that clean, dry, strong, durable and free of another substance, (DPU, 2010).

b. Fine Aggregate

This aggregate has size of particle that passes sieve no.8 (2.36 mm). Fine aggregate consists of sand and artificial sand, or the combination must be clean, dry, strong, and free of clay and other substance. The fine aggregate must have the sharpness and rough particle form, (DPU, 2010)

Filler must be dry, free from clump, and minimum 75% of the weight must pass sieve no. 200 / 75 micron, (SNI 03-4142, 1996). For Asbuton Mineral, filler must pass sieve no. 100 /150 micron and not less than 95 % of the weight. Filler which is added to pavement, it less than 1% from total aggregate. Filler is expected to fill the void between aggregate and it will increase density. Filler influence the stability, durability, and workability of the mix design.In this research, crushed stone ash is selected for filler, (Bina Marga, 2010)

The influences of filler in asphalt pavement are:

a. Make the interlock of aggregate and then increase the stability and density of pavement.
b. Applied the filler as a part of aggregate and it will fill the void between the particles of aggregate, so the strength of the mix should be increase. That happen because of it bonds the material.

c. Characteristics of asphalt are influenced by filler.
d. Viscosity of mix design in high temperature has a lot of wide varieties and depends on the type.
e. In same void content, stability has strong relationship with viscosity.
f. Higher temperature is required for filler to achieve higher consistency.
g. Sensitivity to water can be decreased by increasing filler.

2.4 Additive Material

Additive material is used to modify characteristics of the asphalt in the mix design. Polymer additive may increase melting point, penetration index, skid resistance, cracking and deformation of asphalt. Polymer material will also increase the bonding and softening point of the mix design, (Suroso, 1997).

Considerations to take advantage from the use of waste materials are, (Kandhal, 1993):

1. Engineering concerns:
    a. properties of hot mix asphalt
    b. impact on production
    c. future recyclability
    d. consistency quality
2. Environmental concerns :
    a. leaching
    b. handling and processing procedure
3. Economic concerns
    a. price

b. life cycle cost

c. disposal cost

d. salvage value

e. lack of incentive

2.5 High Density Polyethelyne (HDPE)

HDPE (High Density Polyethylene) is stronger,harder, more opaqueand more resistanttohigh temperatures than LDPE (Low Density Polyethylene). HDPEis commonly used for cosmetics, medicine bottles, beverage bottles, milk bottle, gallons for drinking water, folding chairs, jerry cans, lubricants, and others. HDPEis only recommended forsingle use, because in continuity, it should release and increase SbO3compound(Antimony Trioxide). HDPEmaterialwhenpresseddoes not return toitsoriginalshape. HDPE material has a density from 0.93 g/cm^2– 0.96 g/cm^2, a softening point from 123^{0}C – 127^{o}C and a elasticity modulus from 8.000MPa – 120.000MPa, (Dahniah, 2003).

2.6 HRS-WC

Hot Rolled Sheet is divided into base course (HRS B) and wearing course (HRS-WC). The different between HRS B and HRS-WC are a distribution of aggregate and a level of service. Using HRS B is for medium to high traffic and HRS-WC use for low to medium traffic. The maximum aggregate size of HRS-WC is 19 mm with open gradation, and passes the refusal density requirement from BinaMarga specification. Wearing course is the layers of pavement to resist the skid resistance from the wheel of vehicle. This layer commonly regulated

from asphalt and other material to get a good stability, a water resistibly and a high durability. The minimum thickness of this layer is between 2.5 cm - 3 cm, (Sukirman, 1992)