CHAPTER II

LITERATURE REVIEW

2.1. General Discussion

Because of the large number of people in Indonesia, with the average of every family has their own vehicles, Indonesia has become too crowded and full of congestion, hence gives big impact to so many roads in Indonesia and simply can't balance the road capacity.

According to MKJI, (1997) congestion is a condition in which the flow of traffic passes on the road exceeds the planed road capacity resulting in the free speed of these roads is close to or up to 0 km/hour thus causing delays. Congestion caused by several factors that occur on the highway, for example: sidewalks that is taken over by street vendors thus causing pedestrians to enter the lane for vehicles, crowded human activities around the street, or factor from the illegal parking along its road making the roads used smaller and smaller thus the use of roads is not optimal. This explanation by MKJI has been fulfilled with the view of Indonesia's street mostly everywhere. This congestion will finally and slowly effect the road quality.

2.2. Indonesia's Road & Traffic General Statistic

Indonesia's road & traffic general statistic can be observed and obtained from the Statistical Yearbook of Indonesia (BPS), especially in 2020. Statistical Yearbook of Indonesia 2020 is a publication presenting various data from BPS-

Statistics Indonesia and other agencies. The publication provides general pictures of geographic and climate conditions, government, as well as key socio-demographic and economic characteristics of Indonesia.

According to BPS (2020), The vehicle that uses the main road is motor vehicles. Motor vehicles is every vehicle that driven by existing engineering equipment on these vehicles, it is usually used for transportation of people or goods on the highway. Motor vehicles are all motor vehicles that has been recorded except for TNI / Polri and Corps motor vehicles diplomatic. Data that can be obtained also are:

1. Total length of road in Indonesia is 544,917 km
2. Total passenger car is 17,238,361 units
3. Total bus is 2,541,957 units
4. Total truck is 8,007,542 units
5. Total motorcycle is 126,588,509 units

By the data, it concludes that the total vehicles in Indonesia is 154,376,369 units, which means there is around 232 units' vehicles every km.

2.3. Problem with Heavy Traffic

From the data above, it shows how 'over' is the vehicles, and it supports the fact about the road problems in Indonesia. According to Pais et al. (2013) traffic (i.e. load intensity, frequency, and axle and tire configuration) is primarily responsible for pavement problems due to the loads applied by the axles and tires of vehicles. Heavy traffic causes the most important failures in a pavement producing fatigue cracking and rutting that require pavement rehabilitation. Traffic

on a road pavement is characterized by a large number of different types of vehicles with variations in load magnitude, the number of axles, and the axle grouping. Heavy vehicles can have all type of axles or some combinations of the various type. The different axle types have differing influences on pavement performance. The study carried out in their paper concluded that the effect of vehicle loads is diminished by increasing the asphalt layer thickness.

2.4. Conducted Researches

A lot of research has been carried out to improve and modify asphalt binders with different materials such as polymers, ashes, oils, and nanomaterials. Several studies have been conducted on the impact of polymers on asphalt binder rheology and asphalt mixture performance. Lu and Isacsson (1997) examined the effect of styrene butadiene styrene (SBS) on asphalt binder rheological properties. The results showed adding SBS to asphalt binder increases the elasticity of the asphalt binder at high temperatures and increases its ductility at low temperatures.

Hınısgˇlu et al. (2004) examined the effect of high density polyethylene (HDPE) on asphalt mixture resistance against rutting. The effect of asphalt binder modified with HDPE on sustainability, flow, and Marshall ratio (flow stability ratio) was investigated. The results indicated that adding 4% of HDPE increased Marshall stability and Marshall Quotient value by 50%.

Ahmadinia et al. (2012), examined the effect of poly ethylene terephthalate (PET) on the functional characteristics of stone mastic asphalt. The results indicated a significant decrease in the potential of rutting, and increase in sample stiffness.

2.5. About UHMWPE

This material is a subset of thermoplastic polymers. Its longer chain serves to transfer load more effectively to the polymer backbone by strengthening intermolecular interactions. Muzamil et al. (2020) says according to the International Standards Organization (ISO) (2019), UHMWPE has a molecular weight of at least 1 million g/mole and degree of polymerization of 36,000, while according to the American Society for Testing and Materials (ASTM) (1998), it has a molecular weight of greater than 3.1 million g/mole and degree of polymerization of 110,000. Thus, UHMWPE has high wear-resistance, toughness, durability, and biocompatibility. Therefore, it is commonly used as a bearing material with ceramic or metallic counter surfaces in joint arthroplasty UHMWPE's significance for achieving outstanding performance in total joint arthroplasties is unquestionable.

Research on UHMWPE itself has been conducted on UHMWPE on rheological aspect. Hamedi (2020) says the use of UHMWPE increases the rutting factor in modified asphalt binder, which can reduce the potential of the rutting of asphalt mixings containing these asphalt binders at high temperatures. For example, at 58 °C and for samples containing 2, 4, and 6% UHMWPE, the rutting factor improve by 48.1, 85.9, and 97.5%, respectively.