

## THE EFFECT OF LIQUID ASPHALT ON HIGHWAY FLEXIBILITY

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### *Abstract*

*The purpose of this study was to determine the effect of liquid asphalt on highway flexibility. This type of research is quantitative research with meta-analysis methods. The data source comes from an analysis of 10 national and international journals indexed by SINTA and Scopus. Process data search through ScienceDirect, Google Scholar, ProQuest and Wiley. The keyword is the effect of asphalt on highway flexibility. Data analysis by calculating the effect size value using the SAP application. The results concluded that there was a significant liquid asphalt on highway flexibility with an average value of effect size (  $ES = 0.88$ ) with a high influence category. These findings provide important information for future research into the effect of liquid asphalt on highway flexibility.*

**Keywords:** Liquid asphalt, highway, effect size, road flexibility

### INTRODUCTION

Highways are very important infrastructure in the mobility of people and the transportation of goods. The sustainability and safety of a highway depends largely on its physical condition. One important factor affecting the quality of a highway is its flexibility, which refers to the ability of the road to withstand traffic loads, temperature changes, and ground movement. Good flexibility minimizes cracks and deformation of the road surface and extends the service life of the road. Liquid asphalt has been a key ingredient in highway construction and maintenance for many years (Zarei et al., 2020). Liquid asphalt is used as a binder in asphalt mixtures used for the manufacture of highways (Mensahn & Lugeiyamu, 2022; Carrión et al., 2020) . However, improper use of liquid asphalt can have a negative impact on the flexibility of highways. Therefore, research on the effect of liquid asphalt on highway flexibility is essential to ensure more durable and safe roads (Eze et al., 2023).

Furthermore, factors that can affect the effect of liquid asphalt on highway flexibility include the type of liquid asphalt used, method of use, and application temperature (Saputra et al., 2021). Different types of liquid asphalt have different characteristics, such as viscosity and elasticity, which can affect the flexibility of the road. In addition, the method of using liquid asphalt and its application temperature can also affect the ability of liquid asphalt to bind highway aggregates well (Al-Qadi et al., 2003). The effect of liquid asphalt on highway flexibility can also have an impact on road maintenance costs (Chowdhury et al., 2023). Less flexible roads tend to deteriorate faster, which requires additional costs for repairs and

maintenance (Xiong et al., 2023). Therefore, understanding the effect of liquid asphalt on highway flexibility can help in the development of more efficient and economical construction and maintenance methods (Mulyono, 2023).

Previous studies have been conducted to investigate the effect of liquid asphalt on road flexibility, but there is still room for further research. (Hasrullah et al., 2023) said that the use of liquid asphalt has an influence on road flexibility. This research could yield new insights into the type of liquid asphalt that best suits a variety of climatic and environmental conditions. This can pave the way for innovations in the selection of liquid asphalt materials that can increase the flexibility of highways. Research by Alemu et al., (2023) develops better quality liquid asphalt has the right viscosity, elasticity, and resistance to temperature changes, which can improve highway flexibility. Therefore, this study aims to determine the effect of liquid asphalt on the flexibility of ray a road.

## RESEARCH METHOD

The research This type of research is a meta-analysis study. Meta-analysis is a type of research that collects primary studies that can be analyzed statistically (Razak et al., 2021; Chamdani et al., 2022; Oktarina et al., 2021; Tamur et al., 2020). The data source comes from an analysis of 10 national and international journals indexed by SINTA and Scopus. Process data search through ScienceDirect, Google Scholar, ProQuest and Wiley. The keyword is the effect of asphalt on highway flexibility. The inclusion criteria are research published in 2018-2023, research related to the effect of liquid asphalt on highway flexibility, research data comes from national and international journals, research has complete data to calculate the value of effect size. Data analysis by calculating the effect size value using the SAP application. The criteria for effect size in the study can be seen in Table 1.

**Table 1.** Effect Size Criteria

<b>Effect Size Value</b>	<b>Category</b>
$0.00 \leq ES \leq 0.20$	Low
$0.20 \leq ES \leq 0.80$	Moderate
$ES \geq 0.80$	High

Source :(Cohen et al., 2007)

## RESULT AND DISCUSSION

From research searches through the Google Scholar, ScienceDirect, Google Scholar, ProQuest and Wiley databases related to the effect of liquid asphalt on highway flexibility, 110 journals were obtained. The data will be selected based on predetermined inclusion criteria, so 10 eligible journals are obtained. Data that have met the inclusion criteria are

analyzed based on the year of publication, country, effect size, journal index and effect size criteria. The results of the analysis can be seen in Table 2.

**Table 2.** Data Analysis Meets Inclusion Criteria

<b>Journal Code</b>	<b>Year</b>	<b>Country</b>	<b>Journal Index</b>	<b>Effect Szie</b>	<b>Criterion</b>
<b>A1</b>	2023	English	Sinta	0.86	High
<b>A2</b>	2023	Indonesian	Sinta	1.20	High
<b>A3</b>	2021	Pakistan	Scopus	1.87	High
<b>A5</b>	2020	English	Scopus	2.56	High
<b>A6</b>	2023	China	Scopus	2.10	High
<b>A7</b>	2022	China	Scopus	1.18	High
<b>A8</b>	2022	Egypt	Scopus	0.92	High
<b>A9</b>	2021	Indonesian	Sinta	0.78	Moderate
<b>A10</b>	2020	Indonesian	Sinta	0.63	Moderate
<b>Average Effect Size Value</b>				1.34	High

Table 2, explaining the results of research data analysis that meets the inclusion criteria, obtained the highest effect size value of 2.56 and the lowest effect size of 0.63. According to the effect size criteria (Cohen et al., 2007) 8 high effect size studies and 2 medium effect size studies were obtained. Furthermore, the average value of effect size of 1.34 concluded the influence of liquid asphalt on highway flexibility. The results of the study are in line (Elnaml et al., 2023) liquid asphalt contains chemicals that can affect the flexibility of highways. Liquid asphalt is the basic material used in the manufacture of hot mix asphalt used for the top layer of highways (Albayati, 2023). Road flexibility refers to the ability of a road to withstand vehicle loads, temperature changes, and other external forces without experiencing significant cracks or deformations. The research will identify the extent to which certain types of liquid asphalt affect road flexibility, in both hot and cold weather conditions.

The use of good quality liquid asphalt can increase the flexibility of the highway and extend the service life of the road. Conversely, poor liquid asphalt can cause cracks, deformations, and other damage to the road surface, which will require more frequent repairs and higher costs (Li et al., 2023). Therefore, the selection of the right type of liquid asphalt is very important in the planning and construction of durable highways. In addition to the type of liquid asphalt, other factors such as construction techniques, asphalt mix density, and local climate can also affect the flexibility of the highway. The research will include an evaluation of these factors to understand the more complex relationship between liquid asphalt and highway flexibility.

## CONCLUSION

From this study it can be concluded that there is a significant liquid asphalt on highway flexibility with an average value of effect size ( ES = 0.88) with a high influence category. These findings provide important information for future research into the effect of liquid asphalt on highway flexibility.

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