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Analysis of Binder Absorbent Layer Thickness Using Paper Test

Zikhri Zein [1], Akbar Alfa [2] ✉, Jihan Melasari [3]
[1, 2, 3] Universitas Putra Indonesia YPTK Padang
akbaralfa@upiyptk.ac.id

Abstract

Prime coat is an important layer in flexible pavement because it provides bonding between the granular base and the subsequent asphalt layer. This study aimed to determine the application rate and estimated thickness of prime coat using the paper test method and to compare the results with the technical range stated in the General Specifications 2018. The research used an experimental approach in the Pavement Laboratory of Putra Indonesia University YPTK Padang. Five paper-test samples measuring 25 cm × 25 cm were placed at different test points before manual application of emulsion asphalt. The net asphalt mass retained by each sample was converted into application rate and then into thickness using an asphalt density of 950 kg/m³. The measured application rates were 1.117, 0.766, 0.870, 0.886, and 1.123 kg/m², with an average of 0.952 kg/m². The estimated average thickness was approximately 1.00 mm. All samples were within the specified range of 0.4–1.3 kg/m². The results indicate that the manual application was technically acceptable, although control of spraying uniformity remains important to prevent excessive local application.

Keywords: Prime Coat, Paper Test, Flexible Pavement, Asphalt Emulsion, Thickness.

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1. Introduction

Roads are transportation infrastructure that must be able to provide safe, comfortable services and have performance that is in accordance with the design life. In flexible pavement construction, the quality of the layers is determined not only by the material and thickness of the structure, but also by the quality of the implementation of each stage of the work. General provisions for road management place construction quality as a vital part in maintaining the road's service function [7].

A prime coat is applied to the surface of the aggregate base layer before the next asphalt layer is laid. This layer helps penetrate and bond to the base surface and creates conditions that support bonding with the asphalt layer above it [3], [4]. Therefore, the amount of watering needs to be controlled so that it is not too thin or too thick.

Improper prime coat application can result in surfaces with either too little or too much asphalt. Too little application can reduce the bond quality, while too much application can increase the risk of a slippery surface or interfere with the absorption process into the base layer. The 2018 General Specifications used in this final project stipulate a prime coat weight range of 0.4–1.3 kg/m² [3].

In field applications, distribution monitoring is crucial because manual spraying is heavily influenced by movement speed, the distance of the tool from the surface, and the amount of material dispensed. Paper testing can be used as a simple method to capture the weight of material distributed over a specific area, allowing for calculation of the prime coat quantity. This study focused on testing five points using 25 cm × 25 cm test paper to obtain an overview of the quantity and thickness of the prime coat.

The research problem is that it is not yet known quantitatively whether the results of prime coat spraying at the test points are within the technical limits used. The objectives of this study are to determine the weight of the prime coat at each point, calculate the average value, estimate the thickness based on the specific gravity of liquid asphalt, and assess its suitability to the range of 0.4–1.3 kg/m². [3]

1.1. Road Pavement Construction Context

Road construction is essentially a unified structure that receives vehicle loads and distributes them to the underlying layers. In flexible pavement, this structure is composed of a surface layer, base layer, subbase layer, and subgrade, so the performance of the surface layer cannot be separated from the condition of the supporting layers. In the final project, these layers are described as components that work together to receive and distribute traffic loads.

The loads acting on pavement construction include not only vertical forces due to the weight of vehicles and their loads, but also wheel vibrations and horizontal forces such as braking forces. This condition makes the quality of the connection between layers crucial, as the structure must maintain its bond during repeated loads. A prime coat is one of the tasks that supports the connection between the aggregate base layer and the asphalt layer above it.

In road construction, quality control is essential from material preparation through the implementation process to final inspection. The final project, which served as the basis for this research, positions quality control as a process to ensure the work meets the plans and specifications, ensuring it remains functional throughout its intended lifespan. In prime coat work, quantity control is one aspect that can be directly inspected by measuring the weight of the material captured on a test strip.

1.2. Function of Prime Coat in Pavement Structure

A prime coat is a layer of liquid asphalt applied to the surface of the aggregate base layer before the next layer is laid. In the

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source text, a prime coat is described as a layer that helps bind class A aggregate to hotmix such as AC-BC or AC-Base. Therefore, the success of a prime coat application is determined not only by the presence or absence of asphalt on the surface, but also by its quantity and uniformity of distribution.

Too low a quantity can result in the surface not receiving enough binder, while too high a quantity can result in sections that are too thick or have excess material. The final project states that overcoating needs to be monitored because it can affect absorption and surface condition. Therefore, measurements at several points are important to obtain a more objective picture than visual observation alone.

1.3. Practical Gaps and Research Objectives

The practical gap that underpinned this research was the need to translate the visual results of prime coat applications into quantitative data that could be compared against specifications. Paper testing provides a simple approach because the material captured on the paper can be weighed and converted to weight per unit area. This study then used five test points to examine local variations in application results.

Based on this context, the research objective was expanded from simply determining a single thickness value to three primary outputs: measuring the prime coat weight at each point, obtaining an average value, and assessing the suitability of the results to the technical range used. Thickness was then derived from the weight per unit area using the specific gravity of the liquid asphalt used in the study. This approach remained within the scope of the data and procedures contained in the final project.

1.4. Basis for Conformity Assessment

The basis for the assessment in this study uses a prime coat weight range of 0.4–1.3 kg/m² as stated in the final assignment based on the 2018 General Specifications. This range is used as a comparison limit for all points, not just the average value. Thus, a result is considered satisfactory if the actual value is still between the lower and upper limits used.

In addition to comparing values against specification limits, the discussion also considers the pattern of variation between points. Values approaching the upper or lower limits still require careful attention, even if they are formally considered satisfactory. This perspective is crucial in quality control because implementation quality is not simply a matter of passing or failing, but also how to maintain process consistency.

2. Research methodology

The research used an experimental method with direct testing at the Road Pavement Laboratory of Putra Indonesia University (YPTK) Padang. The data used were primary data from paper tests. The research stages included literature review, material and equipment preparation, testing, data collection, thickness calculation, comparison with specifications, and evaluation of the results.

The materials used are liquid asphalt emulsion and supporting materials. The main equipment consists of a hand sprayer/manual watering tool, bucket or jerrycan, test paper, personal protective equipment, a broom, and weights. Before spraying, the surface is cleaned and ensured to be ready to receive the prime coat.

The test paper was rectangular in shape with dimensions of 0.25 m × 0.25 m, so the area of each sample was 0.0625 m². Five test papers were placed at predetermined test points, then the prime coat was manually sprayed. After the spraying process, the paper was weighed and the weight of the plastic or packaging container was subtracted to obtain the net weight of the prime coat.

The prime coat weight per unit area is calculated using Equation (1), then the thickness is calculated using Equation (2).

$$\mathbf{q = (W_s - W_p) / A} \quad (1)$$

Where q is the weight of the prime coat per unit area (kg/m²), W_s is the weight of the sample (kg), W_p is the weight of the plastic/container (kg), and A is the area of the test paper (m²).

$$\mathbf{t = q / \rho} \quad (2)$$

Where t is the layer thickness (m), q is the weight of the prime coat per unit area (kg/m²), and ρ is the specific gravity of the liquid asphalt (kg/m³). The specific gravity value used in the test is 950 kg/m³.

2.1. Materials and Equipment

The primary research material is liquid asphalt emulsion, which is used as a prime coat. Supporting materials listed in the final project manuscript include kerosene, while the equipment used consists of a hand sprayer, bucket or jerrycan, test paper, personal protective equipment, brooms, weights, and surface cleaning aids. The selection of this equipment follows the research conditions, which use manual watering in the test area.

Test paper is used to catch material that falls on the surface during spraying. The paper size is set at 25 cm × 25 cm so that the observation area is relatively small and can represent local conditions at the test point. After the spraying process is complete, the paper that has received the prime coat is weighed to obtain the total weight, then the weight of the plastic or wrapping is subtracted to obtain the net weight of the material.

2.2. Surface Preparation and Test Paper Laying

Before spraying, the surface of the foundation layer is cleaned of dust, loose material, and dirt. In the procedure described in the final project, cleaning is performed using an air compressor and can be continued manually if loose material remains. The surface must also be dry and undisturbed by rain or wind during spraying.

Once the surface is prepared, test strips are placed at the planned points. A total of five test strips are used to represent the five observation points. They are placed horizontally and weighted to ensure the paper's position remains stable during the watering process. The purpose of this test point arrangement is to ensure the data not only depicts a single location but also demonstrates the variation in prime coat distribution.



Figure 1. Placing the test paper on the test surface (Source: Research documentation, 2025).

2.3. Watering and Data Processing

The prime coat application in the study was performed manually using a jerry can. The material was slowly applied along a specific path, ensuring an even distribution over the test area. After application, the surface was visually inspected for areas that were too thin, too thick, or not sufficiently covered. This step is crucial because the results of the paper test are influenced not only by the amount of material but also by the distribution technique.

Data for each point was calculated based on the difference between the sample weight and the plastic weight. This net value was then divided by the test paper area of 0.0625 m² to obtain the prime coat weight in kg/m². The average value of the five points was then divided by the specific gravity of the liquid asphalt of 950 kg/m³ to obtain the equivalent thickness in meters, which was then converted to millimeters.

As a basis for evaluation, the results of each point were compared with the range of 0.4–1.3 kg/m² used in the final project based on the 2018 General Specifications. With this approach, the assessment was based not only on the average value, but also on the condition of each point. Points with values close to the upper limit were still observed because in practice they could indicate a tendency for overwatering even though the numbers still met the specifications.

2.4. Testing Variables and Parameters

The primary parameter observed was the prime coat weight per unit area (kg/m²). Supporting parameters included the sample weight after spraying, the weight of the plastic or container, the area of the test paper, and the specific gravity of the liquid asphalt. The resulting variables were then compared to the acceptance criteria of 0.4–1.3 kg/m².

The test paper measures 25 cm × 25 cm, or 0.0625 m². Five points are used to ensure the results are not limited to a single location. The net weight of the prime coat is obtained by dividing the total weight of the sample by the weight of the plastic, then dividing by the area of the paper to obtain the weight per unit area.

2.5. Sequence of Testing Implementation

The implementation sequence starts from literature study, preparation of materials and tools, inspection of surface conditions, placement of test paper, prime coat application, paper collection, weighing, data processing, comparison to specifications, and preparation of conclusions. The flow follows the research chart in the final project. The test is experimental because the data is obtained directly from testing activities at the Road Pavement Laboratory of Putra Indonesia University YPTK Padang.

Table 2. Research stages and outputs of each stage

Stage	Main activities	Output
1	Literature study	Theoretical basis and specifications
2	Preparation of materials and tools	Materials and equipment ready
3	Surface cleaning	Surface ready to receive prime coat
4	Placing 5 test papers	Observation points available
5	Manual watering	Prime coat distributed
6	Weighing	The sample weight obtained
7	Calculation	kg/m² and thickness
8	Comparison	Status meets/does not meet
9	Interpretation	Conclusion and recommendations

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2.6. Equations and Units

The calculation follows the basic principle that the weight of the material per unit area is obtained by dividing the net weight of the material by the area of the test medium. The equivalent thickness is then obtained by dividing the weight per unit area by the specific gravity of the liquid asphalt. The conversion is performed while maintaining consistency between kilograms, square meters, and meters.

The equation used is $q = (W_s - W_p)/A$ to obtain the weight of the prime coat per unit area, while the thickness is calculated by $t = q/\rho$. In this study, $A = 0.0625$ m² and $\rho = 950$ kg/m³. The resulting values are then expressed in kg/m² for specification evaluation and millimeters to express the equivalent thickness.

3. Results and Discussion

Test results showed variations in prime coat quantity at five points. This variation was a consequence of manual watering, but all values remained within the technical range. The test results are summarized in Table 1.

At point 1, the net weight of the prime coat, 69.8 grams, yields 1.117 kg/m². This value is relatively high compared to other points, but still below the maximum limit of 1.3 kg/m². This indicates that the surface receives a greater amount of material at that point.

Point 2 yielded the lowest value, at 0.766 kg/m². This value remains above the minimum limit of 0.4 kg/m², thus still meeting specifications in terms of quantity. This difference may be attributed to the amount of watering, the speed of movement, or the distance of the watering from the surface, as observed during manual application.

Points 3 and 4 yielded values of 0.870 kg/m² and 0.886 kg/m², respectively. Both values are quite close to the average and indicate a relatively stable distribution. Meanwhile, point 5 yielded the highest value of 1.123 kg/m², but still within the specification range.

The average of five points was 0.952 kg/m². With a specific gravity of 950 kg/m³, the theoretical average thickness was calculated to be 0.0010 m or approximately 1.00 mm. This value indicates that overall the watering was within the technical limits, although differences between points still need to be considered as part of quality control. [3]

Table 2. Results of prime coat weight testing with paper test

Point	Sample weight (g)	Plastic weight (g)	Prime coat (kg/m²)	Information
1	87.5	17.7	1,117	Fulfil
2	65.5	17.6	0.766	Fulfil
3	70.2	17.6	0.870	Fulfil
4	73.0	17.6	0.886	Fulfil
5	88.0	17.8	1,123	Fulfil
Average			0.952	Fulfil

Source: Primary data from testing results in final assignment, 2025.

Compared to the range of 0.4–1.3 kg/m², the minimum value of 0.766 kg/m² still has a safe difference of 0.366 kg/m² from the lower limit, while the maximum value of 1.123 kg/m² is still 0.177 kg/m² from the upper limit. Thus, there are no points outside the specification range. However, point 5 requires attention because it has the highest value and can practically indicate the need to control the movement and rate of watering.

These results align with the roadwork quality control principle that materials and processes must be controlled against specifications before the next layer is applied. Paper-based inspection provides a simple way to evaluate the actual quantity of water received by the surface, especially when watering is done manually. In the context of this study, this method also provides data that is easy to calculate and compare between points.

The average thickness calculation indicates a value of approximately 1.00 mm. This value is the equivalent thickness based on the ratio of the weight per unit area to the specific gravity of the liquid asphalt, making it more appropriate as a quantitative estimate than a direct geometric measurement. With this approach, the paper test can be used as a simple quality control tool to assess the consistency of prime coat application.

The limitations of this study lie in the limited number of test points and the manual application of the sprayer. Further research could expand the number of points, compare manual sprayers with distributors, and test various emulsion types and concentrations to determine their effect on spread, penetration, and long-term coating performance.

3.1. Prime Coat Quantity Analysis

The calculation at the first point used a sample weight of 87.5 grams and a plastic weight of 17.7 grams, resulting in a net prime coat weight of 69.8 grams. With a paper area of 0.0625 m², the resulting value was 1.117 kg/m². This value is 0.183 kg/m² below the maximum limit of 1.3 kg/m² and indicates that the amount of material at that point is relatively large compared to the other points.

At the second point, the net weight of the prime coat, 47.9 grams, yielded a value of 0.766 kg/m². This was the lowest value of all tests, but still 0.366 kg/m² above the minimum limit of 0.4 kg/m². The difference from the first point shows that manual watering can produce significant local variations.

The third point yielded a net weight of 54.4 grams, or 0.870 kg/m². This value is close to the average and can be considered fairly representative of the general test conditions. The fourth point yielded 55.4 grams, or 0.886 kg/m², which is also relatively close to the average.

At the fifth point, the net weight of the prime coat reached 70.2 grams, resulting in a result of 1.123 kg/m². This value is the highest, even slightly higher than the first point. While still within specification limits, this result requires caution, as uncontrolled addition of material at a single point can result in uneven distribution.

3.2. Thickness and Uniformity Analysis

The average value of five points is 0.952 kg/m². If a liquid asphalt density of 950 kg/m³ is used, the equivalent thickness is calculated as 0.0010 m, or approximately 1.00 mm. This value is the result of converting mass per area to thickness based on the assumed density used in the test.

The test results ranged from 0.357 kg/m² to 1.123 kg/m². All values were within the technical limits, so there were no quantitatively failing points. However, this variation suggests that evaluation based solely on averages can mask local differences; therefore, multiple point inspections are more informative for quality control.

Practically, values approaching the lower limit need to be monitored to prevent them from developing into areas of material shortage, while values approaching the upper limit need to be controlled to prevent them from becoming puddles or excessively thick layers. In this study, points 2 and 5 represent the two most contrasting conditions. Point 2 indicates the lowest amount, while point 5 indicates the highest amount.



Figure 2. Manual prime coat application (Source: Research documentation, 2025).

3.3. Discussion on Quality Control

Quality control for prime coat work essentially requires ensuring that the materials used are appropriate and that the amounts applied to the surface are within the planned range. Research shows that paper testing can provide quantitative results that can be directly compared with specifications. This makes the method relevant as a simple inspection before proceeding with the next asphalt layer.

From a practical perspective, variations between points can be explained by the nature of manual watering. Hand movement speed, tool distance from the surface, watering direction, and watering duration can affect the amount of material absorbed by the surface. Therefore, consistent use of techniques is a crucial part of quality control, not just post-completion inspections.

The findings at point 5 indicate that a value that meets specifications does not necessarily mean the distribution is optimal under all conditions. High values still require attention, as excessive layers can inhibit absorption into the

base layer and potentially affect bond quality. Conversely, lower values, such as those at point 2, still require monitoring to prevent the surface from becoming deficient.

Thus, paper testing can be implemented as part of a simple, practical quality control program. Periodic testing of multiple points can help operators identify watering tendencies before applying the next coat. This approach also aligns with the research process for final projects, which involves collecting primary data, calculating values, comparing them to specifications, and assessing the thickness of the prime coat.

3.4. Test Data Recapitulation

Table 3. Recapitulation of paper test results.

Point	W sample (g)	W plastic (g)	Net W (g)	q (kg/m²)	Status
1	87.5	17.7	69.8	1,117	Fulfil
2	65.5	17.6	47.9	0.766	Fulfil
3	70.2	17.6	54.4	0.870	Fulfil
4	73.0	17.6	55.4	0.886	Fulfil
5	88.0	17.8	70.2	1,123	Fulfil
Average	76.84	17.66	59.54	0.952	Fulfil

Table 3 shows that the total sample weight and net weight do not always correspond to the prime coat values when roughly compared, so subtracting the plastic weight is an important step before calculating. The highest net weight is at point 5, at 70.2 grams, while the lowest is at point 2, at 47.9 grams. This difference results in an application range of 0.357 kg/m².

3.5. Calculation of Each Test Point

Point 1 yields a net weight of 69.8 grams. Dividing 0.0698 kg by the area of 0.0625 m² yields 1.117 kg/m². This value is still 0.183 kg/m² below the upper limit of 1.3 kg/m², so it meets the specifications.

Point 2 yields a net weight of 47.9 grams. Dividing this by the paper area yields 0.766 kg/m². This value is 0.366 kg/m² above the lower limit of 0.4 kg/m², so it still meets the requirements, but it is the point with the lowest application compared to the other four points.

Point 3 yields a net weight of 54.4 grams, or 0.870 kg/m². This point is fairly close to the midpoint of the specification range and, according to the final project description, is considered a fairly ideal condition. The value does not indicate a tendency for extreme material shortages or excesses.

Point 4 yielded a net weight of 55.4 grams, or 0.886 kg/m². This value is very close to point 3 and the average of the five points. The close proximity of the two points indicates that irrigation in this area is relatively stable.

Point 5 yielded a net weight of 70.2 grams, or 1.123 kg/m². This is the highest value, but still 0.177 kg/m² below the maximum limit. The final project attributed this high value to possibly longer watering times, shorter spraying distances, or less even hand movements.

3.6. Simple Statistical Analysis

As an additional analysis of the five points, the average value based on the test figures was 0.952 kg/m², rounded to 0.952 kg/m² as in the source report. The population standard deviation of the five points was 0.143 kg/m², and the coefficient of variation was approximately 15.0%. This value indicates that there is variation between points, but all observations are within the accepted range.

The coefficient of variation was not used as a formal acceptance limit because the final project did not specify specific CV criteria. The figure was used solely to clarify the level of dispersion of the obtained data. Therefore, technical decisions were still based on comparing individual results within the range of 0.4–1.3 kg/m².

3.7. Relationship between Quantity and Equivalent Thickness

The average value of 0.952 kg/m² was converted using a specific gravity of 950 kg/m³, resulting in a thickness of 0.0010 m, or 1 mm. Conceptually, this calculation demonstrates that the mass of material distributed over a given area can be expressed as thickness if the specific gravity of the material is known. This result helps connect the paper test measurement with the term thickness used in the research objectives.

It's important to distinguish between the calculated equivalent thickness and the geometric thickness measured directly using a measuring instrument. In this study, the 1 mm figure represents the conversion of mass per area to the specific gravity of liquid asphalt, so its interpretation must follow the assumptions of the calculation. This approach remains consistent with the method used in the final project.

3.8. Evaluation of Implementation Quality

Overall, the implementation can be considered satisfactory in terms of quantity. There were no results below 0.4 kg/m² or above 1.3 kg/m². However, the range of 0.766–1.123 kg/m² indicates that manual techniques produce distribution differences that need to be controlled to prevent greater variation across the wider work area.

Observations of points 2 and 5 provide contrasting conditions. Point 2 is closest to the lower limit, while point 5 is closest to the upper limit. Both still pass, but quality control requirements indicate that operators need to maintain control over the speed, distance, direction, and amount of material released during flushing.

3.9. Implications for Field Work

The research results provide practical implications: paper tests can be used as a simple inspection before proceeding with the next asphalt layer. Multiple-point testing can help identify areas prone to material shortages or excesses. If discrepancies are found, the final project recommends corrections in the form of additional spraying on deficient areas and specific treatments for excess areas.

For field implementation, consistency of spraying technique is crucial. The final project recommends the systematic use of spraying equipment for more even distribution. For further research, variations in emulsion type, mixing concentration, number of points, and post-application evaluation can be used to expand on the research findings.

Table 4. Summary of quality control based on research results

Control aspects	Research conditions	Evaluation
Surface conditions	Cleaned and conditioned before watering	In accordance
Test media	25 × 25 cm paper	In accordance
Number of dots	5 points	Fulfilled
Application limits	0.4–1.3 kg/m²	Fulfilled
Minimum value	0.766 kg/m²	Fulfilled
Maximum value	1,123 kg/m²	Fulfilled

Control aspects	Research conditions	Evaluation
Average	0.952 kg/m²	Fulfilled
Equivalent thickness	1.00 mm	Fulfilled

3.10. Further Discussion: Position of Prime Coat in Pavement System

Test results should be viewed as part of a flexible pavement system, not as a stand-alone project. The aggregate base layer serves as the structural component that receives and distributes loads, while the asphalt layer above it serves as the surface layer that absorbs traffic and environmental influences. The prime coat is located at the junction of the two layers, so its quality can influence the working relationship between the layers.

In the final project, a prime coat is described as a layer of liquid asphalt applied before the next layer of asphalt. This positioning makes the success of the project highly dependent on the condition of the base layer surface. A surface that is still dusty, contains loose material, or is unprepared can reduce the effectiveness of the applied material because some of the material does not interact with the aggregate surface as expected.

Therefore, the cleaning procedure performed before the paper test is more than just an administrative preparation step. Cleaning with a compressor and additional sweeping aims to achieve a cleaner and more stable surface. Good surface condition makes it easier to attribute measurement results to the watering process, rather than to the presence of contaminating materials on the surface.

The relatively high results for points 1 and 5 indicate that successfully meeting specifications does not automatically mean the process is uniform. Point 1's value was 1.117 kg/m², while point 5's was 1.123 kg/m². Both figures are within the 1.3 kg/m² limit, but indicate that some locations received more material than points 2, 3, and 4.

From a quality control perspective, these conditions can provide the basis for improving execution techniques. Operators can use more consistent motion patterns, maintain tool-to-surface distances, and control material discharge rates. Periodic checks with test paper can help ensure that these technique changes actually result in a more stable distribution.

Thus, the paper test serves two purposes in this research. First, this method provides quantitative figures to assess whether the material quantity is within the required range. Second, the differences between points can be used as feedback to improve the watering process, especially for manual work.

3.11. Further Discussion: Variation Between Test Points

The five test results show a fairly clear pattern. Point 2 has the lowest value at 0.766 kg/m², points 3 and 4 are in the middle group with values of 0.870 and 0.886 kg/m², respectively, while points 1 and 5 are in the higher group with values of 1.117 and 1.123 kg/m². This pattern indicates that manual watering produces spatial variation across the test surface.

Variations can occur due to the characteristics of the manual spraying process. When pouring or spraying material, small changes in hand speed and distance from the surface can alter the amount of material falling on a given area. Furthermore, the direction of movement and the duration of spraying in a given location can also cause some areas to receive more material.

Point 2 is an example of a section that requires attention if similar conditions occur during fieldwork. While the value still meets the lower limit, the distance from the lower limit is smaller than the other points. In broader work settings, small variations can become more significant if watering techniques are not consistently controlled.

Conversely, point 5 indicates conditions approaching the upper limit. A value of 1.123 kg/m² is still lower than 1.3 kg/m², but localized excess material should still be avoided. The final project paper states that spreading too thickly can inhibit absorption into the aggregate layer and potentially result in poor surface conditions.

Points 3 and 4 can be used to illustrate results that are relatively close to the average value. The values of 0.870 and 0.886 kg/m² differ by only 0.016 kg/m². The closeness of these two results indicates that the watering process in this area is more stable than the difference between points 2 and 5.

This difference also highlights the importance of the number of test points. If only one point is used, research results can be unduly influenced by local conditions. Five points provide a better picture of variation and allow researchers to determine average values while identifying the lowest and highest points.

To develop the test, the number of points can be increased to allow for more detailed analysis of the distribution pattern. Systematic placement of points in both longitudinal and transverse directions would help indicate whether variation tends to occur in a particular direction. However, such development is beyond the scope of the research reported in this thesis.

3.12. Further Discussion: Quality Control and Specification Conformance

Prime coat quality control can be divided into three stages: pre-application inspection, during application, and post-application inspection. Before work begins, the surface must be clean, dry, and ready to receive the material. During application, uniformity of application and application quantity must be controlled, while after application, the results are checked through observation and measurement.

In this study, paper testing primarily served as a post-application inspection. However, the information generated can also be used to improve subsequent implementation stages. If a point shows a low score, the operator can evaluate the watering technique and make corrections before continuing the work.

The 0.4–1.3 kg/m² criterion provides a clear threshold for evaluating the results. All five points fall within this limit, formally confirming that all results are satisfactory. The average of 0.952 kg/m² also falls well short of both limits, indicating generally acceptable test conditions.

However, quality control should not stop at the conclusion of compliance. The values of 1.123 kg/m² at point 5 and 0.766 kg/m² at point 2 indicate a range of 0.357 kg/m². This range is not problematic according to the specifications used, but it does indicate that manual techniques still produce differences that need to be monitored.

A better approach is to use the measurement results to control the process. If several points in a row show low values, the watering technique needs to be adjusted. If the values tend to be high, the amount of material or the watering rate needs to be controlled to keep it from approaching the maximum limit.

In the context of construction work, this type of control helps prevent decisions based solely on visual observations. A surface that appears wet may not necessarily have the same quantity of material throughout the entire site. Paper testing converts these observations into numerical data that can be recorded, compared, and used as a basis for evaluation.

Conformance to specifications also provides the basis for deciding whether to proceed to the next stage of the project. In this study, because all results fell within the acceptable range, the prime coat application was deemed feasible in terms of quantity. However, field decisions must still consider other requirements not tested in the study, such as curing conditions, cleanliness, and the readiness of subsequent coats.

3.13. Further Discussion: Implications, Limitations, and Research Directions

The main implication of this research is that a simple method can be used to provide a quantitative overview of prime coat application results. The use of 25 cm × 25 cm test paper allows for relatively simple measurements on small areas. The resulting data can then be calculated as weight per unit area and compared directly with technical limits.

The first limitation is the sample size. Five points are sufficient to illustrate the variation in this test, but not enough to fully describe the working conditions on a long road section. Therefore, applying the research results to a broader project should consider the need for larger samples and a more representative distribution of points.

The second limitation relates to the spraying method. The study used manual jerrycans, so the results were heavily influenced by the operator. While this is useful for examining variations in manual spraying, it doesn't compare the performance of this method with asphalt distributors used on large-scale projects.

The third limitation is that the study focused on quantity and equivalent thickness. The study did not directly measure the bond strength between the base layer and the subsequent asphalt layer, did not specifically evaluate the penetration of the prime coat into the aggregate, and did not observe performance after receiving traffic. Therefore, the study's conclusions are limited to the results of quantity testing and its compliance with the specifications used.

Nevertheless, the results provide a sufficient basis for further research. Future studies could compare several types of asphalt emulsions, several application rates, and two spraying methods: manual and distributor. These results could be related to penetration characteristics, uniformity, curing time, and post-consumer coating performance.

Further research could also expand the measurement method. In addition to the weight of the material on the paper, observations could be supplemented with visual documentation, surface condition measurements, and evaluations after the asphalt layer has been laid. This way, the relationship between the amount of prime coat and the quality of the bond between the layers could be analyzed more thoroughly.

Overall, the study demonstrated that paper testing could be part of a simple quality control system for prime coat applications. The results of five spots that all met specifications, averaging 0.952 kg/m², and an equivalent thickness of approximately 1 mm, provide a basis for acceptable performance under test conditions. However, process consistency remains a key concern, as variations between spots indicate the influence of manual spraying techniques.

The most immediate practical recommendations are to maintain surface cleaning procedures, maintain surface condition before spraying, control spraying techniques, and conduct multiple point inspections. This approach aligns with the quality control principles emphasized in the final project, namely ensuring work conforms to plans and specifications before further work is undertaken.

4. Conclusion

The paper test method can be used to simply evaluate the quantity and distribution of prime coat based on the weight of the material collected on the test paper. Five test points yielded prime coat weights of 0.766–1.123 kg/m², all within the specification range of 0.4–1.3 kg/m².

The average prime coat value was 0.952 kg/m². With a liquid asphalt density of 950 kg/m³, the average equivalent thickness obtained was approximately 1.00 mm. These results indicate that the implementation of this test met the applicable technical limits.

Although all samples met specifications, variations between spots indicate that manual spraying techniques still need to be controlled. More systematic use of spray equipment and regular inspection with paper tests can help maintain uniform prime coat distribution.

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