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Review of Factors Influencing the Performance of Hot-Applied Joint Sealant

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ABSTRACT

The current practice in Iraq showed that satisfactory sealing of joints for concrete structures is not always achieved. The poor quality of local sealants is usually considered the main cause of such improper performance. The purpose of this work, therefore, is to review and investigate the factors affecting the performance of thermoplastic hot-applied joint sealers which are mostly used in horizontal joints of rigid pavements as shown by the literature reviewed in this study. The impact of different compositions including asphalt cement, reclaimed rubber, mineral filler, fiberglass and, polyvinyl chloride, together with the effect of manufacturing procedures and materials' percentage are studied. Sealant physical properties have been evaluated to include consistency at normal temperatures, resistance to flow at elevated temperatures and, resistance to failure in adhesion or cohesion at very low temperatures. It has been determined that the desired hot-applied sealant can be produced from locally available materials to satisfy the performance-related properties after using optimum contents of asphalt cement (about 45%), reclaimed rubber (about 20%), mineral filler (about 25%), fiberglass (0.1-0.6%), and polyvinylchloride and dioctyl-phthalate (10-15%), in addition to controlling the suitable mixing temperature (170°C) and installing temperature (120-130 °C). This work shall provide a better understanding of the factors influencing the local manufacture of a more durable hot-applied sealant for concrete joints.

Keywords: Joint-sealant, Hot-applied, Rubber, Filler, Adhesion.

1. INTRODUCTION

The purpose behind providing joints in most concrete structures is to allow for movement resulting from variations in temperature due to season differences in temperature and moisture, initial drying shrinkage and possible chemical reactions **(Stępień et al., 2023)**. Cracking or distortion in the concrete slab may be caused by the restraint of contraction

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or expansion movements because of the development of excessive tensile or compressive stresses of damaging magnitudes within the structure or to abutting units **(Veropalumbo et al., 2022)**. The provision of contraction, expansion and construction joints is one of the means that can minimize such effects since such movements can be accommodated without loss of integrity of the structure **(Alawneh et al., 2023)**. Joints usually create openings which require sealing to prevent the intrusion of gases, liquids or foreign solid matter and protect the concrete against damage.

The sealer is expected to deform in a composite elastic and plastic manner as a joint opens and closes, thus complying with the joint movement without affecting its ability to maintain the seal **(Wang et al., 2023**). A number of factors determine the functioning of the sealer at any time such, as the type and shape of the joint, movement to be accommodated, changes between installation and service temperatures and, the physical properties of the sealer used **(Wu et al., 2020)**. It is a common experience that satisfactory sealing is not always achieved **(Guoqiang et al., 2020)**. The sealant used, or its poor installation, usually receives the blame, whereas often there have been deficiencies in the location or the design of the joint that would have made it impossible for any sealant to have done good conduct **(Yiqiu et al., 2013)**. The primary function of the joint sealant is to prevent water and incompressible materials from entering and damaging the pavement system **(Qian et al., 2020; Gong et al., 2021)**. Improper performance of joint-sealant may lead to serious deterioration of the adjacent concrete slabs. Such deteriorations may include corrosion to dowels and tie bars. Softening of the subgrade is expected due to the water intrusion or even joint pumping due to the trapped water in the joint. Furthermore, spalling of concrete may occur due to the expansion of inert materials used in sealing concrete joints **(Guoqiang et al., 2020)**.

In order for the sealant to perform its primary function, the joint sealing material should remain in contact with the joint faces to resist the intrusion of water and incompressible materials at all temperatures encountered, it must also remain pliable and resilient at these temperatures **(Yang et al., 2021)**. The material should not become excessively soft during hot weather, or hard and brittle during cold weather. If the sealant softens during hot weather, it becomes susceptible to the intrusion of foreign materials and can sag deeper into the joint or be tracked out into the pavement by the action of the traffic. At low temperatures, the sealant must be ductile enough to withstand elongation and flexural strain without separating from the joint face or tearing internally **(Batista et al., 2017)**. The field-molded joint sealers used in local practice include cold-applied, hot-poured, and jet-fuel-resistant types **(Alawneh et al., 2023)**. In Iraq, determining the proper sealant to meet all the desired requirements for specific applications is a common problem. The properties of available sealers include inhomogeneity in manufactured materials, and poor installation usually receives the blame in this field.

The aim of this research, therefore, is to review the factors that could influence the performance of the hot-applied joint sealant, and to find out the possibility of controlling these factors in order to maintain the sealant in good condition. To achieve the objective of this study, the procedure aimed firstly to review previous studies to find a combination of materials that could produce a satisfactory sealant based on accurate percentages and a relatively successful method of production and secondly to investigate the factors that could influence the performance of the desired sealant represented by changes in rubber gradation, filler type, ratio of PVC: DOP (Polyvinyl chloride: Dioctyl phthalate), mixing temperatures, and changes in the percentage of each material.

2. TYPES OF JOINTS

There are many types of joints in concrete slabs according to their function or purpose. These joints need to be filled with a suitable sealant to work properly **(Nelson et al., 2023).** Such types of joints in concrete structures can be summarized as follows:

1) Expansion Joints
The main purpose of expansion joints is to accommodate thermal expansion and contraction of concrete due to temperature variations **(Guoqiang et al., 2020)**. Typically, these joints are placed in long stretches of concrete pavement, bridges, and buildings. Compressible materials are used in such sealants or equipped with expansion joint systems to absorb movement **(Roman et al., 2016)**.

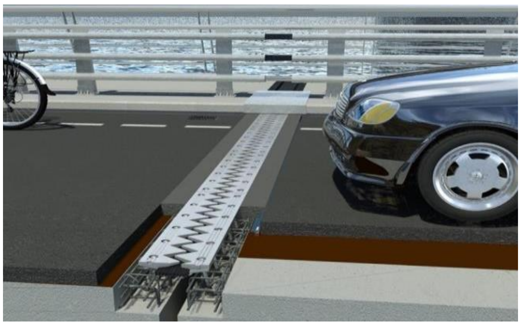

Figure 1. Illustration of expansion joints **(Dronfield, 2024)**

2) Dowel Joints
These joints are used to transfer loads across joints and prevent differential settlement. They are usually located on concrete pavements or slabs. Steel dowel bars are commonly used to provide load transfer **(Smith and Romine, 1994),** as shown in **Fig. 2.**

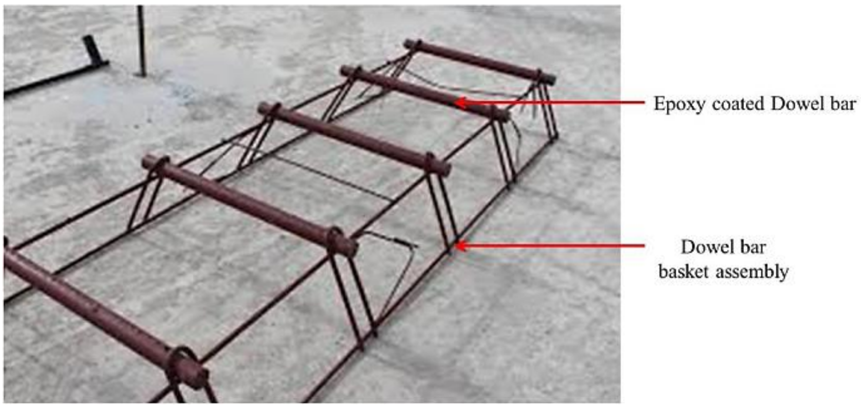

Figure 2. Assembly of dowel joints before applying concrete **(Singh et al., 2023)**

3) Contraction Joints
The main objective of construction joints is to control shrinkage cracking during the curing process (**Fig. 2**). Therefore, the location is predetermined based on the expected pattern of cracking. These joints may be left as formed joints or filled with joint fillers **(Shuang et al., 2016)**. **Fig. 3** shows an example of such joints.

Figure 3. An example of contraction joints **(Mulders, 2024)**

4) Construction Joints

To facilitate construction in phases or pours, this type of joints is used (**Fig. 4**). It is located where one day's work stops and the next begins. May require special construction joint materials to maintain structural integrity **(Smith and Romine, 2001)**.

Figure 4. Example of construction joints **(Steffen, 2023)**

5) Isolation Joints

In some cases such as where a building meets a foundation or where a pavement meets a structure, isolated joints are used to separate different parts of a structure and prevent the transfer of loads and vibrations (**Fig. 5**). Often filled with joint filler materials to isolate the segments **(Shuyin et al., 2020)**.

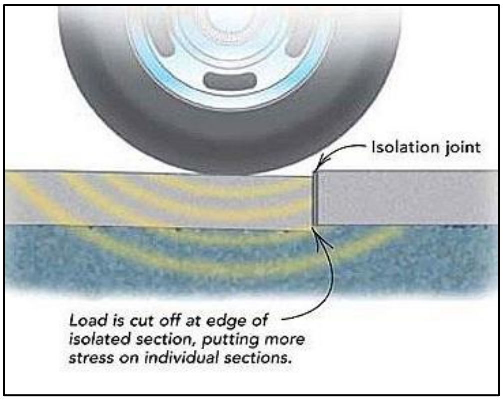

Figure 5. Illustration of Isolation Joints **(Fisette, 2024)**

6)Armored Joints
This type of joints is used to protect joints from heavy traffic loads such as highways, runways, and industrial floors and reduce maintenance (**Fig. 6**). Rmor plates or load transfer devices **(Santagata et al., 2016)**.

Figure 6. An Installed Armored Joint **(Scansem Materials, 2024)**

7) Saw-Cut Joints
They are useful in creating controlled cracks in the concrete in large slabs where shrinkage cracks are expected (**Fig. 7**). The joint may be left as is or filled with joint fillers (**Brigitte et al., 2006**).

Figure 7. Saw-Cut Joints at the construction site **(Rahman, 2024)**

8) Voided Slabs Joint
Often used in parking structures and bridge decks to allow for vertical movement while still providing load transfer (**Fig. 8**). Usually, it is equipped with systems that can accommodate both movement and load transfer.

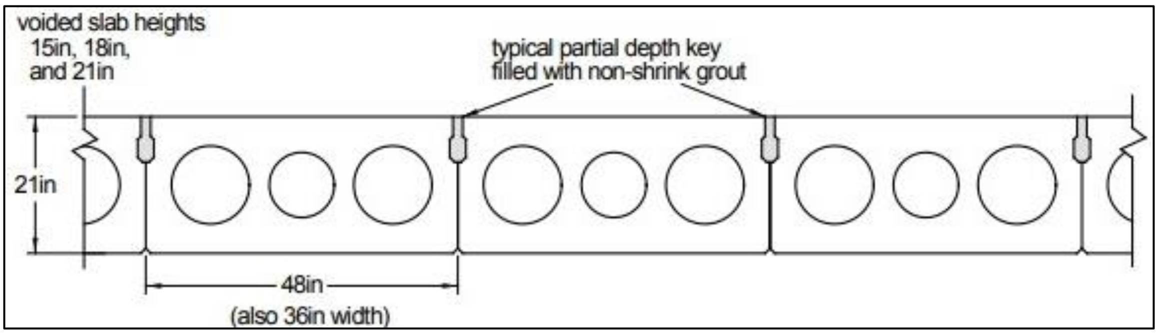

Figure 8. Voided Slab joint **(Kedar et al., 2017)**.

3. COMPOSITION OF JOINT-SEALANT

Joint-sealant composed of several materials to achieve its function **(Pérez et al., 2008).** The first trials in this field dealt with a mixture of asphalt and natural rubber only. Some researchers developed a method for rubberizing asphalt with natural rubber in latex form and determining whether certain arbitrary characteristics of the materials could be improved as cited by (**Alawneh et al., 2023)**. They showed that by adding small amounts of sulfur to the latex, the blending condition could be improved and the effectiveness of the rubber on the asphalt would greatly be increased **(Yildirim et al., 2007)**. As compared with blends prepared with latex alone, the addition of small amounts of sulfur produced the following effect: It reduced the time and temperature of blending; improved the storage stability; increased low-temperature ductile properties and increased toughness and tenacity **(Dhuha et al., 2021)**. They also showed that the properties of asphalt rubberized with natural rubber latex could be varied not only by the amount of rubber but also by using different amounts of sulfur. Based on the asphalt, the amount of sulfur required to produce the above changes was very small. The maximum amount used was 0.6%

3.1 Hot-Applied Joint Sealants

The hot applied joint sealants are products which are used in civil engineering constructions to seal the joints in several structures particularly rigid pavements and bridges **(Iwański et al., 2022)**. These sealants are normally applied in a molten form and then they cure and therefore give a flexed and strong bond due to the formation of a polymeric network **(Munch et al., 2020)**. The main function of hot-applied joint sealants is to reduce water and other undesirable elements, and debris, in the joints thus increasing the durability of the structure.

3.1.1 Composition and Types

- Bituminous Materials: Hot applied joint sealants predominantly rely on bituminous materials, that could comprise asphalt or modified asphalt materials **(Pérez et al., 2008).**
- Polymeric Materials: Some formulations add polymers to the components to improve flexibility, bonding capability, and general effectiveness **(Pouyan et al., 2023).**
- Types: Joint sealants that are hot-applied can be categorized based on their composition and are further discussed below Hot-pour asphalt sealants Hot-pour polymer-modified sealants

3.1.2 Key Characteristics

- Flexibility: Being exposed to hot temperature conditions, hot-applied sealants must be capable of expansion in order to compensate for the movements that occur within joints arising from changes in temperatures, traffic load and many other factors as identified **(Liu et al., 2014).**
- Adhesion: The key success of the sealant in providing a good barrier to water is dependent on the adhesion that it provides to the joint surfaces **(Munera and Erick, 2014).**
- Cohesion: Intrinsic bonds and integrity do not allow the division or destruction of the molecules of the sealant even if pressure is applied to them **(Shaoquan et al., 2022).**
- Resistance to Environmental Factors: Hot applied sealant should be able to withstand the

effects of aging, UV batters, chemical attacks as well as other factors **(Zahraa et al., 2023).**

3.1.3 Application Process

- Heating: The sealant is usually in a sold shape and it's required to be in a liquid state at some point which is usually in some special equipment.
- Preparation: Contact areas are lowered and empty of any keep by using least force to definite correct mating.
- Application: Its performance is done in its hot state and is applied in a liquid-state and then poured or pumped into the joint to ensure that it fills it due to the available space for the joint.
- Cooling and Solidification: This process also eradicates the issues of fresh-air infiltration and develops hard skin, which is also non-absorbent since it forms a new polyurethane surface that seals all cracks and openings **(Fig. 9).**

Figure 9. Process of applying joint-sealers **(Woods, 2020)**

3.1.4 Applications

- Pavement Joints: The hot applied sealants are widely used in concrete and asphalt pavements to seal the expansion joints, contraction joints, and other types of movement joints **(Pouyan et al., 2023).**
- Bridge Decks: For bridges, these sealants are placed in the joints and around to keep water from seeping in and ruining the infrastructure.
- Airport Runways: Essential to the longevity of runway joints under high traffic loads.

3.1.5 Factors Influencing Performance

- Material Selection: The selection of the material of the sealant is based on parameters such as weather conditions, traffic conditions, and substrate type **(Faheem and Bahia, 2010).**
- Temperature: The correct application temperature is a fundamental aspect because under or over-temperature will affect the flow and adhesion properties of any good quality powder. Feedstock.
- Surface Preparation: For good adhesion and performance, the joints must have clean and well-prepared surfaces **(Feng et al., 2022)**
- Joint Design: The joint design and size affect the type and quantity of sealant to be used.

3.1.6 Maintenance and Inspection

- Regular Inspections: Periodic inspections are necessary to identify any signs of sealant degradation or failure **(Sun et al., 2020)**.
- Prompt Repairs: Damaged or deteriorated sealant should be promptly repaired or replaced to maintain the integrity of the joint seal **(Tan et al., 2020)**.

3.1.7 Advantages

- Waterproofing: Effective at preventing water infiltration, and protecting the structure from damage.
- Flexibility: Adaptable to joint movements without cracking.
- Durability: Can withstand harsh environmental conditions and heavy traffic loads.

3.1.8 Challenges

- Maintenance: Needs to be inspected regularly and maintained to counter act wear.
- Installation Complexity: Correct installation is critical, and the process may be more difficult than other sealing methods.

In short, as far as the structure of civil engineering is concerned, hot-applied joint sealants are exceptionally reasonably necessary for their care and longevity. The correct choice, correct application, and proper maintenance of these sealants are necessary to avoid water penetration and maintain the strength of pavements, bridges, and other infrastructure elements.

3.2 Types of Sealants

Sealants may be classified into two main groups, field-molded and preformed.

3.2.1 Field-molded

Field-molded sealants are those applied in liquid or semiliquid form and thus are formed into the required shape within the mold provided at the joint opening **(Li et al., 2017)**. The filed-molded sealant could be divided into the following types:

3.2.1.1 Mastics

Sealants with putty-like properties are composed of viscous liquids with fibers and fillers. They are used in buildings for caulking, glazing, precast panels and vertical wall joints where very small joint movements are anticipated **(Delaporte et al., 2008; Buannic et al., 2012)**. The composition may include low- melding point asphalts, and drying or nondrying oils. With any of these, a wide variety of fillers is used including asbestos fiber, fibrous talc or silicone materials. Most mastics harden with time due to oxidation and loss of volatiles causing a reduction in service life.

3.2.1.2 Thermoplastics Sealants

The thermoplastic sealants consist of:
1) Hot-applied sealants: These are materials which become soft on heating and harden on

cooling usually without chemical change **(Carter et al., 2005)**. They are generally black and include asphalt, rubber asphalt, pitches, coal tars, and rubber tars. Though initially cheaper than some of the other sealants, their effective life is, in practice, shorter. They tend to lose elasticity and plasticity with age, accept rather than reject foreign materials, and extrude from joints that close tightly or that have been overfilled.

Overheating during the melting process adversely affects the properties of those compounds containing rubber **(Gong et al., 2022)**. Those with an asphalt base are softened by hydrocarbons, such as oil, gasoline, or jet fuel spillage. Tar-based materials are fuel and oil-resistant and these are preferred for service stations, refuelling and vehicle parking areas, and airfield aprons. They have been widely used in pavement joints.

2) Cold-applied (solvent or emulsion type): These materials are set either by the release of solvent or the breaking of emulsions on exposure to air. Sometimes they are heated to a temperature not exceeding 49°C to facilitate application but usually, they are handled at ambient temperature **(Dondi et al., 2014)**. Sealants that use solvents or water can shrink and harden over time. This makes them less flexible and reduces the amount of movement they can accommodate in a joint. This can lead to problems with the seal and ultimately affect how well the joint functions. These types of sealants, such as acrylic, vinyl, and modified butyl, come in various colors but are best suited for joints with minimal movement..

3) Thermosetting sealants:

The thermosetting sealants include:

a) Chemically curing sealants: In this class are either one- or two-component systems which cure by chemical reaction to a solid state from the liquid form in which they are applied. They include polysulfide, silicone, urethane and epoxy- based materials **(Smith and Romine, 2001a)**.

Sealants are popular for various applications because they excel in several key areas:

- Resistance to Weather and Ozone: They withstand harsh outdoor conditions without degrading.
- Flexibility and Resilience: They remain flexible and can absorb movement at both high and low temperatures.
- Chemical Inertness: They are compatible with many chemicals, including solvents and fuels in some cases.
- Abrasion and Indentation Resistance: They are particularly resistant to scuffing and deformation.

Thermosetting chemically curing sealants have an expansion compression range of up to ±25 percent depending on the one used, at temperatures from (-40 °C to +82°C). Silicone sealants remain flexible over an even wider temperature range. They have a wide range of uses in buildings and containers for both vertical and horizontal joints or on pavements **(Ghaidaa et al., 2021)**. Though initially more expensive thermosetting-chemically curing sealant can stand greater movements than other field- molded sealants, and generally have a much longer service life.

b) Thermosetting solvent release: Another class of thermosetting sealants are those which are cured by the release of solvent **(Subhy et al., 2018)**. Chloro-sulfonated polyethylene and certain butyl and neoprene materials are included in this class and their performance characteristics generally resemble those of thermoplastic solvent-release materials **(Golewski, 2022)**. They are less sensitive to variation in temperature once they have "setup" on exposure to the atmosphere. Their cost is somewhat less than that of other elastomeric sealants and the service life is likely to be satisfactory.

3.2.2 Preformed Sealants

Preformed sealants are functionally preshaped, usually at the manufacturers' plant, so that only a minimum of site fabrication is necessary for installation **(Shen et al., 2005)**. Traditionally, preformed sealants have been subdivided into two classes: rigid and flexible. Most rigid preformed sealants are metallic; examples are metal water stops and flashing. Flexible sealants are usually made from natural or synthetic rubbers, polyvinyl chloride and like materials, and are used for water stops **(Zhilin et al., 2020)**.

4. TESTING METHODS

In order to study the factors influencing the performance of the hot-applied joint sealant, the following steps have to be taken first:
1) The investigation of materials, their percentages and procedures that could produce the desired sealant. The materials used may include:
• Asphalt grade 40-50 **(Ma et al., 2019)**.
• Reclaim Rubber: graded between sieve No (30-200) **(Gong et al., 2022a)**.
• Fiber Glass **(Mohammed et al., 2022)**.
• Limestone dust
• PVC 40% plus DOP 60% **(Lou et al., 2021)**.
Trial mixes can be used to find out the proper percentage as well as the suitable method of production. The preliminary evaluation of the prepared sealant is by penetration, flow and bond tests according to **(ASTM D3406, 2017)** for hot-applied elastomeric sealant.
2) The investigation into the effect of variation in materials type, materials percentage and production temperature on performance-related properties of sealant which include the following variations
• Rubber grades between sieve No (8-16), (16-30), (50-100), (16-200), and (30-200)
• Filler types: cement, sulfur, and coloring powder
• The ratio of PVC: DOP 20:80 and 60:40
• Variation in asphalt percentage 35%, 45%, and 55%
• Variation in rubber percentage 7%, 19.7%, and 29.7%
• Variation in fiber glass percentage 1%, 0.3%, and 0.6%
• Variation in limestone dust percentage 15%, 25%, and 35%
• Variation in the percentage of PVC&DOP 5%, 10%, and 15%
• Producing temperatures 170, 150 and 120 °C **(Masson et al., 2005; Pérez et al., 2008)**
After this step, the sealant is prepared for the next step of testing to determine factors affecting its performance.

4.1 Cone Penetration at 25 °C

Cone penetration is a measure of the consistency of the material and has no significant value in predicting performance **(Mingjun et al., 2020)**. The maximum specified limit of 90 dmm may impose worsening of the low-temperature behavior of the crack material because it limits material softness. The softness of crack sealant is more effectively monitored by the flow at 60 °C. The cone penetration test is more or less redundant **(Qian**

et al., 2020).

4.2 Flow at 60 °C

The flow test is important from a performance perspective to ensure the material stays in the crack at the highest temperatures experienced during the summer **(Jianmin et al., 2021).** The specified value is 3 mm. This requirement may be too severe. Surface oxidation of the crack sealant inhibits flow very early after placement and generally flow has not been seen as a problem in the field **(Zhang et al., 2020)**.

4.3 Resilience at 25 °C

The resilience test by virtue of its design may eliminate crack sealants that perform very well in the field. This test measures the rebound of the crack sealant, requiring a 60% recovery in 20 seconds **(Guan et al., 2022)**. The demand to have a material which recovers very quickly requires formulations of crack sealants with high amounts of rubbery polymers. The cohesive strength in produced crack sealants may be too high **(Soda, 1961)**. A balance needs to be achieved between the resilience and the ductile flow of the sealant especially at cold temperatures **(ASTM D6690, 2001)**.

4.4 Flexibility at -25 °C

The low-temperature flexibility test gives some indication of sealant brittleness but relates little to its actual performance. This test may be helpful if the material is placed on a roof **(Putman et al., 2010)**.

4.5 Bond Test

The bond test is performed under two sets of conditions, either at -29 °C for 3 cycles, non-immersed and immersed or at -18 °C for 5 cycles **(Saikia et al., 2008**). Specimens are examined after each extension for cracks or separations (**Fig. 10**). This test has created controversy for the past 30 years **(Chen et al., 2021**). The bond test is considered very unreliable and has poor repeatability. Many authors have questioned its validity because materials that passed the bond test in the laboratory showed very poor results when applied in the field and vice versa **(Alawneh et al., 2023a)**.

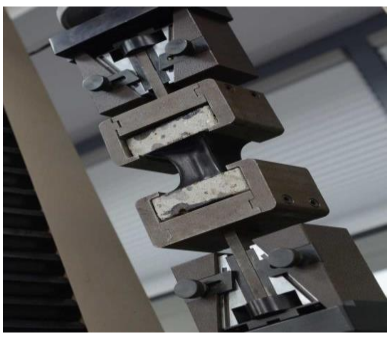

Figure 10. Setting up of bonding test **(Wagner, 2024)**

4.6 Compression Resistance

This test determines the sealant's ability to recover its original shape after prolonged compression. **(ASTM D1204-14, 2020)** is a standard used for this property **(Golewski et al., 2023)**.

4.7 Weathering Test

The sealant is then subjected to accelerated weathering UV radiation, rain and freeze-thaw cycles to test how well it holds up over time. The UV exposure test was in accordance with the **(ASTM G154, 2023; Cao et al., 2020). (ASTM D4585/D4585M, 2018)** also includes a procedure for measuring water immersion resistance **(Fenglei et al., 2018).**

4.8 Chemical Resistance

This test exposes the sealant to various chemicals it might encounter in service (cleaning agents, de-icing salts) to assess its ability to maintain properties without degradation **(Khaji et al., 2021; Zhang et al., 2022). (ASTM D471-16a, 2021)** is a standard for determining resistance to chemical exposure.

5. CONCLUSIONS

This review established that joint sealants are essential for concrete structures performance as well as for rigid pavements, bridges, and buildings construction. However, there are a number of conditions that may affect a sealant’s performance. These conditions should be considered in order to determine which product would be most appropriate and to select the proper application procedures. According to the studies reviewed, testing standards, it can be concluded that:

1) Sealants can be categorized in so many forms and each type has got different characteristic or property. Various aspects such as the expected high/low temperatures, the number of vehicles expected to pass through the particular surface, and the need for flexibility in the type selected.
2) The preparation of a definite type of sealant influences its primary properties. They include adhesion capability to various surfaces, flexibility, capacity to withstand specific factors such as water and ultraviolet light, and squeezing capacity.
3) During the practical term of the study, it has been noted that a good bond between the joint surfaces and the sealant is important to maintain adhesion. Good bonding can be achieved by ensuring that the surfaces of the joint sides are clean prior to the application of sealant. This helps to avoid early failure of the sealant.
4) Width and depth used in construction and the geometry such as rectangular or V-shape also play an important role in the stress that is placed on the sealant. This should be a key factor when deciding on the type of sealant to use as well as the technique of its application.
5) Non-climatic handling of the application, adequate sealant bulk for application and a good finish is crucial for longer use. All measures should be taken according to the manufacturer’s guidelines and adhere to the standards that are widely accepted.

6) A combination of high and low temperatures can make the sealant to crack up or fail to bond cohesively to the surfaces it is meant to join; it also may harden and therefore cannot freely move with the gaps created by the building's expansion and contraction. Moreover, it is necessary to choose a sealant that can effectively work under the right temperature for the intended application.
7) Leakage of water in the underlays erodes the sealant interface and reduces its potential. Proper selection of sealant material, which should be water-resistant, and the design of good sections to minimize water pooling must be observed. Some aspects of exposure to the ultraviolet light consequences are destruction of some joint sealants. When it comes to long-term exposure or when it comes to photochemical reactions, the need to use a UV-resistant sealant or protective gear might arise.
8) To achieve a sealant that meets the standards, optimum contents of asphalt cement (about 45%), reclaimed rubber (about 20%), mineral filler (about 25%), fiberglass (0.1-0.6%), and polyvinylchloride and dioctyl-phthalate (10-15%) were selected.
9) A mixing temperature of (170°C) was found to be suitable to produce a reliable sealant. Additionally, an installation temperature of (120-130 °C) was found as the optimum temperature to ensure adhesion between the sealant and concrete slab.

Credit Authorship Contribution Statement

Haydar Raheem: Writing – review & editing, Writing – original draft, Validation, Methodology, conclusions.
Nabeel N. Salman: Testing of materials, writing - review, Methodology.
Dmytro Mansura: Writing – review & editing, Validation, Conclusions, References

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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مراجعة العوامل المؤثرة على أداء مادة منع تسرب الفواصل الساخنة

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الخلاصة

أظهرت التجربة الحالية في العراق أن كفائة عمل مواد ختم المفاصل لفواصل الهياكل الخرسانية لا سيما الطرق الكونكريتية, لا يتم طبق المواصفات لمطلوبة دائمًا. عادة ما تكون هذه المواد بجودة متدنية ولا تقاوم التغيرات المناخية. وبالتالي فإن الغرض من هذه الدراسة هو استعراض البحوث التي تناولت هذا الموضوع و انواع المفاصل وابرز خصائصها وكذلك لتحليل العوامل التي تؤثر على أداء مادة ختم المفصل والتي تستخدم في الغالب في المفاصل الأفقية للطرق. تمت دراسة تأثير المكونات المختلفة بما في ذلك الرابط الإسفلتي والمطاط والمواد المالئة والألياف الزجاجية والبولي فينيل كلورايد مع تأثير عمليات التصنيع ونسب المواد. تم تقييم الخصائص الفيزيائية للمادة المانعة للتسرب لتشمل التجانس عند درجة الحرارة العادية، ومقاومة التدفق عند درجة حرارة مرتفعة ومقاومة الفشل في الالتصاق أو التماسك عند درجة حرارة منخفضة جدًا. لقد تم تحديد العوامل المؤثرة في جودة عمل هذه المواد لتلبية الخصائص المتعلقة بالأداء بعد استخدام المحتويات المثلى من الإسفلت (حوالي 45%) والمطاط المستعمل (حوالي 20%) والمواد المالئة (حوالي 25%). والألياف الزجاجية (0.1-0.6%)، والبولي فينيل كلوريد وثنائي أوكتيل فثاليت (10-15%)، بالإضافة إلى التحكم في درجة حرارة الخلط المناسبة (170 درجة مئوية) ودرجة الحرارة بالموقع (120-130 درجة مئوية). يوفر هذا العمل فهمًا أفضل للعوامل التي تؤثر على التصنيع لمواد مانعة للتسرب في المفاصل أكثر متانة يتم وضعها للفواصل الخرسانية

الكلمات المفتاحية: مادة مانعة للتسرب، التنفيذ الساخن، مطاط، فلر، تلاصق