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Abstract. Seaweed is one of the natural sources usually use in industrial food, cosmetic, pharmaceutical and fertiliser. A natural polymer material such as seaweed is found to have excellent bonding mechanism and also the critical factor to achieve sustainability. Malaysia is also rich with seaweed species like *Eucheuma Cottonii*. The future study was carried out seaweed species from Malaysia especially seaweed from Sabah. This research aimed to investigate the relationship of a few chemical properties namely physical properties, metal element content, microstructure image and chemical component of seaweed type of *Eucheuma Cottonii* for modifying concrete. This research is mainly base on experimental works. That powdered seaweed from *Eucheuma Cottonii* was analysis using Energy Dispersive X-Ray (EDX), Scanning Electron Analysis (SEM) and Fourier Transform Infra-Red (FT-IR). All the procedure of the laboratory work complies with the specified and relevant standard. The research had shown that Euchema Cottonii powder content suitable for metal and component to bind together with concrete. Concrete with seaweed powder is alternative to become green construction material for sustainable concrete

1. Introduction

Seaweed is one of the natural sources usually use in industry food, cosmetic, pharmaceutical and fertilizer [1] Seaweeds are a multibillion-dollar industry worldwide, providing food, fertilizers, nutritional supplementation, and valuable phycocolloids like agar, carrageenan, and alginate [2]. Seaweed are taxonomically diverse group of marine plant and classified based on plant colour as green, brown and red [3]

The east coast of Peninsular Malaysia and west coast of Sabah and Sarawak waters in the border to the South China Sea is rich with marine resources. A total of 364 taxa of marine seaweed were reported to come from the South China Sea area of Malaysia [4]. 98.9% of seaweed aquaculture concentrated in 7 Asian countries such as Malaysia, Japan, North Korea, South Korea, Indonesia and Philippines [5]. Malaysia is also rich in seaweed species such as *Kappaphycus Alverazii*. Based on its variety of usage,

seaweed industry can provide opportunity towards commercialisation. At the same time, the industry can create jobs and improve the socio-economic of the farming community

Previous study found that seaweed has rheological properties that act as a gel and thickening agent. This properties may perform as epoxy resin to bind composite materials such as concrete [6]. Eucheuma Cottonii and Gracilaria sp may be applied as natural polymer. These species showed excellent performance in building and condensing and can improve bonding strength [7]. The natural polymer modified mortar is expected to perform as an excellent bonding mechanism to enhance the strength and enhanced the durability of concrete. These are the key factors for concrete to achieve sustainability. Seaweed provides the advantage as emulsifier, suspensor, condenser and stabilizer [8]. Seaweed precipitate is a rich source of calcium, silica and carbonate material. The compressive strength of the test specimen of 10% and 20% cement replacement with seaweed precipitate was found to increase to that of the control specimens [9]. Seaweed was also used in the development of unfired brick. According to Dove [10] who conducted a study on renewable materials in the United Kingdom, found that it can help to improve the whole life cycle impact of buildings. Furthermore, the characteristics of seaweed that are group into polysaccharide (containing *Kappa Carrageenan*) potentially act as a strong gel when added together in concrete. Polysaccharide is a biopolymer extracted from plants. It is used as cement admixtures and provides several advantages as bonding properties to mortar. Polysaccharide gums in cement paste system have a significantly higher effect on the viscosity at low shear rate than at higher shear rate [11]. The study on seaweed for concrete is still new and only few findings are available. Furthermore, the findings by other researcher are still at the fundamental stage [12]. However, test results on its potential as binding agent is remarkable as reported by [6] and [10]. Therefore, this study will provide conclusive findings on the potential of seaweed in term of chemical properties. The test results from the experimental work will be used to determine the ideal species of seaweed for concrete additive

This research aimed to investigate the relationship a few of chemical rheology properties namely physical properties, metal element content, microstructure image and chemical component of seaweed type of Eucheuma Cottonii for modifying concrete. The finding from the study will be able to solve some of the problems that arise in the construction sector towards creating a healthy and safe environment

2. Material and Method

The material used in this research is seaweed. The species of seaweed used are in powder type. Eucheuma Cottonii content cellulose of polysaccharide Kappa Carrageenan. Kappa Carrageenan supplies by Tawau Carrageenan (TACARA) from Tawau Sabah. Kappa Carrageenan is product extract from seaweed Eucheuma Cottonii. Figure 1 below shows the Kappa Carrageenan Powder and figure 2 show the raw material of Eucheuma Cottonii.

Figure 1. *Kappa* Carrageenan Powder from *Eucheuma Cottonii.*

Figure 2. Seaweed species of the *Eucheuma Cottonii* in its natural surrounding.

Figure 3. Equipment of Element Analysis an SEM.

2.1 Method Element Analysis

Element analysis is done using Energy Dispersive X-Ray (EDX) equipment. EDX is dominant for the study of metal element surface of Kappa Carrageenan. Metal element of material such as ferum, calcium, zink, ion, magnesium can be define using this method. The important part of this method to define content of Sulphate in the material. Sample with sulphate content will be reluctant because it not suitable and will be affect when it mix with concrete.

2.2 Scanning Electron Microscopy (SEM)

Scanning Electron Microscopy (SEM) used on Kappa Carrageenan powder specimens. It will be shown the size internal structure image of Kappa Carrageenan powder clearly

2.3 Fourier Transform Infra-Red (FT-IR)

Analyze sample directly on filters without any visual presorting, when the environmental sample filtered, purified and extracted can be done by Fourier Transform Infrared (FTIR) [13]. Fourier Transform Infra-Red (FT-IR) analysis was performed using Perkin Elmer 1000. The equipment and method of the experiment shown in fig 4. FT-IR analysis of seaweed powder has been conducting, to identify the possible chemical bonding to determine the natural polymer type of Kappa Carrageenan. The presence of organics such as O-H Oxygen Component and N-H nitrogen Component has been defining.

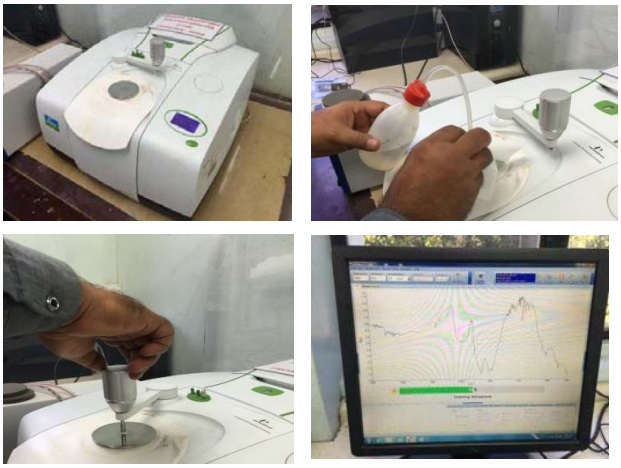

Figure 4. The method of FT-IR done in the lab.

3. Results, Analysis and Discussion

3.1 Physical Properties Analysis

The physical properties analysis of Kappa Carrageenan provided by Tawau Carrageenan as shown in Table 1. The properties offer the type of Seaweed, the percentage of moisture content, Viscosity, pH, water gel strength, yeast and mould, colour and mesh. From the result, Kappa Carrageenan is alkaline with pH 9.5. Concrete is also alkaline, it similar and suitable to mix. From the water gel strength, result shown that the Kappa Carrageenan water gel strength is 700 g/mm. It's ideal as an additional binder for concrete when it mixes

Table 1. Physical Properties Analysis of Kappa Carrageenan.

Properties	**Kappa Carrageenan** Sources : Tawau Carrageenan
Aspect	Powder
Moisture Content (%)	12
Viscosity	50 (1.5% Solution at 75C)
pH	9.5 (1.5% solution at 60C)
Water Gel Strength (g/mm^2)	700
Yeast and Mould	300
Colour	Creamy
Mesh	>90% Pass 150 Mesh

3.2 Element Analysis and Microstructure Image of Seaweed

Energy Dispersive X-Ray Analysis (EDX) results shown in Figure 5 indicate the presence of Carbon, Oxygen, Sodium, Magnesium, Aluminium, Silicon, Potassium, Calcium Ion and Copper in the seaweed powder precipitate with a predominant peak at 2θ (Bragg's angle). Meanwhile, Scanning Electron Analysis (SEM) have revealed the shape and structure of precipitates as shown in Figure 6. At a magnification of 500x, it shows the width diameter is 8.4 mm. The form and structure of precipitates shown, it has similarity to polysaccharide gum and natural polymer

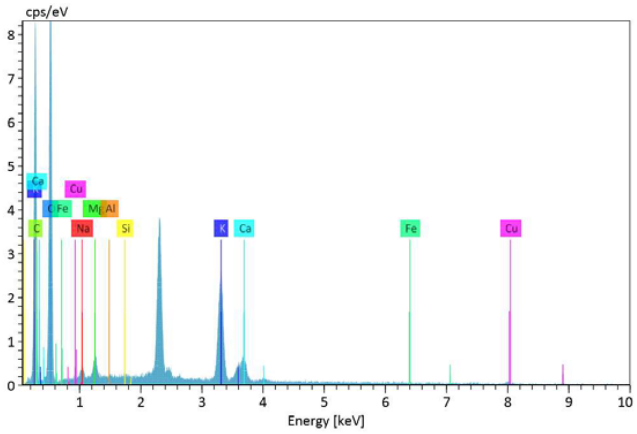

Figure 5. Energy Dispersive X-Ray Analysis (EDX) of Kappa Carrageenan.

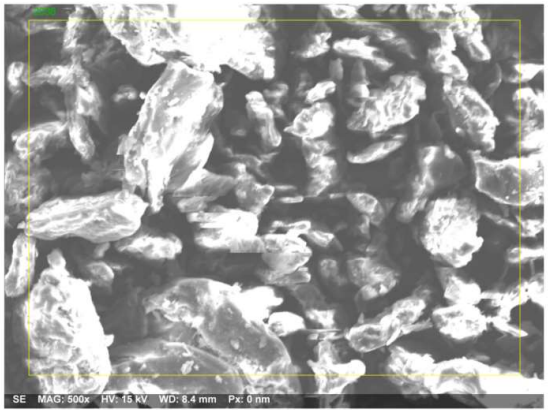

Figure 6. Scanning Electron Analysis (SEM) of Kappa Carrageenan.

3.3 Fourier Transform Infra-Red (FT-IR) Analysis

The presence of organics such as O-H Oxygen Component and N-H nitrogen Component has shown in figure 7. From Fourier Transform Infra Red Test, it showed the cappa carrageenan specimen content a Carboxylic acid O-H group at 2920.81 cm^{-1} and Amine/ amide secondary (N-H) at 3365.43 cm^{-1}. From the result, a large number of hydroxyl (OH) groups markedly increases their affinity for binding water molecules rendering them compounds. From the result, a large number of hydroxyl (-OH) groups considerably increases their affinity for binding water molecules presenting them compounds. Hydrocolloids area heterogeneous group of long-chain polymers (polysaccharides) characterised by their property of forming viscous dispersions or gels when dispersed in water [14]. Hydrocolloid generally refers to substances that form gels or provide viscous dispersion in the presence of water. Alginate, agar, and carrageenan are three commercially valuable hydrocolloids derived from certain brown and red seaweed, and each has their distinct physicochemical properties [15]

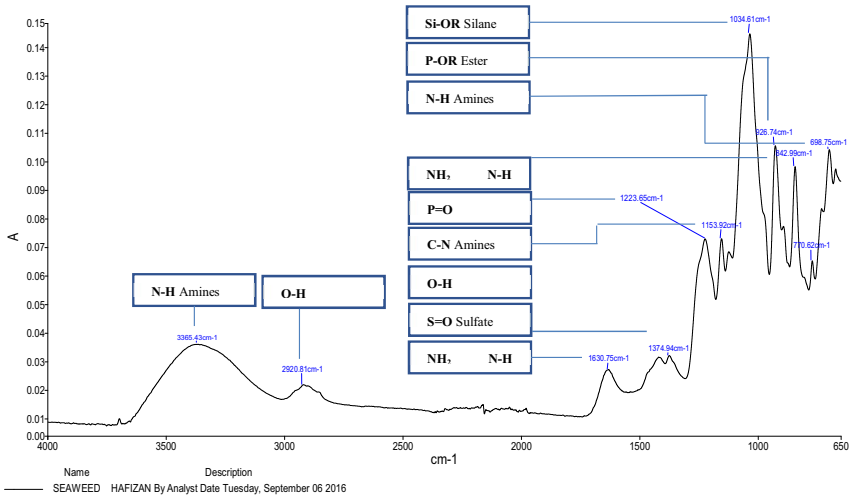

Figure 7. Fourtier Transform Infra-Red (FT-IR) for Polymer Identified

4. Conclusion

Experimental work had been carried out to study the chemical properties of extract seaweed named Kappa Carrageenan. The findings from the metal element content result shown that Kappa Carrageenan content Carbon, Oxygen, Sodium, Magnesium, Aluminium, Silicon, Potassium, Calcium, Iron and Copper. The result showed it free from sulphate content. From Fourier Transform Infra-Red (FTIR) test, it showed the cappa carrageenan specimen content a Carboxylic acid O-H group at 3365.43 cm^{-1} and Amine/ amide secondary (N-H) at 1630.75 cm^{-1}. From chemical properties, seaweed from *Eucheuma Cottonii* is an alternative material to existing concrete mixture to develop green construction material for sustainable concrete. Future research should be done to define the properties of concrete with seaweed.

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