



## Evaluation of Some Properties of Asphaltites Widely Found in Sirnak Province in Terms of Usability in Agriculture

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### ABSTRACT

One of the most important criteria for obtaining quality and abundant crops in agricultural production is a sufficient level of soil organic matter content. It is very important to ensure the use of natural coal-based organic matter resources such as gyttja and leonardite, which are available in our country, in agricultural areas. Sirnak is a province with rich coal deposits. In this study, some properties of asphaltite samples taken from mineral reserves in Sirnak province were investigated in terms of their usability in agriculture. For this purpose, pH, electrical conductivity (EC), lime (%), organic matter (%), ash (%), and humic acid (%) contents of the asphaltites were determined. According to the results of the research, the average pH of the asphaltites was determined as 7.58, EC as 2.95 mS cm<sup>-1</sup>, and lime content as 28%. Organic matter contents ranged from 32-40%, with an average ash content of 38% and an average humic acid content of 8.8%. Although the organic matter content of the asphaltites in the region is high, the humic acid level is low.

**Key words:** Sirnak, asphaltite, agriculture, humic acid, gyttja

### Şırnak İlinde Yaygın Olarak Bulunan Asfaltitlerin Tarımda Kullanılabilirlik Açısından Bazı Özelliklerinin Değerlendirilmesi

#### ÖZ

Tarımsal üretimde nitelikli ve bol ürün almanın en önemli kriterlerden bir tanesi toprak organik madde içeriğinin yeterli düzeyde olmasıdır. Ülkemizde mevcut olan gıda ve leonardit gibi kömür orijinli doğal organik madde kaynaklarının tarım alanlarında kullanımının sağlanması oldukça önemlidir. Şırnak, zengin kömür yataklarına sahip bir ilimizdir. Bu çalışmada, Şırnak ilinde bulunan maden rezervlerinden alınan asfaltit numunelerinin tarımda kullanılabilirlik açısından bazı özellikleri araştırılmıştır. Bu amaç doğrultusunda asfaltitlerin pH, elektriksel iletkenlik (EC), kireç (%), organik madde (%), kül (%) ve hümik asit (%) içerikleri belirlenmiştir. Araştırma sonucuna göre asfaltitlerin ortalama pH 7.58, EC 2.95 mS cm<sup>-1</sup> ve kireç içeriği %28 olarak belirlenmiştir. Organik madde içerikleri ise %32-40 aralığında değişirken ortalama kül %38 ve ortalama hümik asit %8.8 olarak belirlenmiştir. Bölge asfaltitlerinde organik madde içeriği yüksek olmasına rağmen hümik asit düzeyi düşüktür.

**Anahtar Kelimeler:** Şırnak, asfaltit, tarım, hümik asit, gıda

## INTRODUCTION

One of the most important factors influencing high-quality and abundant crop production is undoubtedly the organic matter content of soils. In addition to improving the physical properties of soils, organic matter contributes to plant production by containing plant nutrients and providing an energy source for soil microorganisms. Nearly 50% of our country's agricultural soils have an organic matter content of around 1-2% (Taban et al., 2013). According to the analysis results of 10,000 samples collected from our agricultural soils between 2011 and 2014 as part of a project conducted by the Central Research Institute for Soil, Fertilizer, and Water Resources, 99% of our agricultural soils are deficient in organic matter (<3%). For agricultural soils to achieve the desired physical, chemical, and biological properties and productivity potential, their organic matter content must constitute at least 3% of the soil weight. The inadequate organic matter content of our agricultural soils, and the fact that this inadequacy increases over time, can be attributed to our inadequate management of existing manure and other organic matter resources in agricultural fields, our current climate with low rainfall and high average temperatures, and improper tillage techniques, particularly stubble burning, that constantly disrupt the soil. To raise and maintain the organic matter content of all our soils to 3%, 2 billion tons of organic fertilizer (containing 60% organic matter) is needed once and 800 million tons of organic fertilizer (containing 60% organic matter) are needed annually. It's impossible to procure and apply this much organic fertilizer to our soils, but at least the organic fertilizers we have should be used correctly and effectively. The sources of organic matter in our soils can be listed as follows: 1. Stubble, 2. Barn manure, 3. Composts, 4. Urban waste, 5. Leonardite, 6. Green manure, 7. Humic acid and others, and 8. Meat grinders and slaughterhouse waste (Gezgin, 2018). Asphaltites, found in significant quantities in Sirnak and its surrounding areas, have physical and chemical properties similar to coal. However, they differ from coal due to their formation sources and chemical processes. Asphaltites are separated from liquid petroleum by tectonic processes and settled in other locations. They harden and transform into a solid phase through chemical reactions throughout geological processes. Most of the heating needs in the Southeastern Anatolia Region are met by asphaltites. However, due to their low calorific value and high ash, sulfur, and moisture content, they are a low-calorie raw material with a high potential for negative air pollution. They contain nitrogen and humic acid, which dissolves slowly in aqueous environments, and can be used as soil enhancers (Taşkesen et al., 2022). Humic acids are very dark-colored materials with molecular weights ranging from 50,000 to 100,000. Humic acid is found in decomposed organic matter, peat, coal beds, and soil (Özkan, 2008). One of the most important reasons why plant roots can easily absorb nutrients in environments containing organic materials such as leonardite and gyttja, and why they increase the availability of micronutrients, is due to the humic and fulvic acids they contain (Padem and Öcal, 1999; Pettit, 2012). Gyttja applications to agricultural soils have been found to improve soils chemically and biologically, as well as increase the adsorption of heavy metals (Cd, Pb, Ni, and Zn) and soil organic matter content (Karaca et al., 2006, Korkmaz et al., 2021). In their study, Saltalı and Alhashemi (2022) aimed to determine the Zn sorption properties of gyttja, leonardite, and compost used in organomineral fertilizer production. As a result of the study, the Zn sorption values of gyttja, leonardite, and compost conformed to the Langmuir and Freundlich isotherms. The maximum sorption capacities ( $q_{max}$ ) of these materials are very similar. Considering these data, it was determined that 1

kg of organic material can retain approximately 15 g of Zn. Akgül et al. (2022) aimed to investigate the effects of gyttja and cadmium (Cd) treatments on dry matter yield, Cd, and mineral nutrient uptake (phosphorus, potassium, calcium, magnesium, iron, copper, zinc, manganese) of bread and durum wheat varieties grown under Cd applications. Because gyttja applications can reduce Cd transport to durum wheat in Cd-polluted areas and increase the transport of mineral nutrients, their use is recommended. Saltalı et al. (2015) investigated the effects of gyttja application on soil quality. The mean pH and EC values of the soils did not change statistically when compared to control soils at all application rates. Gyttja applications were shown to have no negative impact on soil quality parameters such as soil EC. Soil organic matter content increased with increasing gyttja applications, and these increases were found to be statistically significant. Gyttja is formed by the accumulation of organic materials and their mixing with inorganic materials on lake bottoms, which are lower in quality than leonardite. It contains approximately 30-40% lime and 40-50% organic matter, and its color varies from light gray to brown and black depending on the lime content. Gyttja also has the potential to be used as a soil conditioner in the improvement of acid soils or in the production of organomineral fertilizers for acid soils (Saltalı and Korkmaz, 2015). A study investigating the effects of gyttja application on sunflower yield and soil properties in alkaline soils reported that gyttja application to soils statistically significantly increased soil organic matter content, sunflower seed yield, fresh head weight, stem weight, and head diameter (Saltalı and Yıldırım, 2016).

In short, one of the most important criteria for achieving high-quality and abundant agricultural yields is a sufficient level of soil organic matter. Ensuring the utilization of existing coal-based natural organic matter resources, such as gyttja and leonardite, is crucial. Sirnak and its surrounding area are rich in coal deposits. In this study, some properties of asphaltite samples taken from the mine reserve in Sirnak province were investigated for their agricultural usability.

## **MATERIAL and METHODS**

### **Material**

In this study, nine different asphaltite samples (A.1, A.2, A.3, A.4, A.5, A.6, A.7, A.8, A.9) extracted from different mines were collected from this influential Sirnak province.

### **Method**

The asphaltite samples were shade-dried and crushed with a wooden mallet to prepare them for analysis. pH, EC, lime, organic matter, ash, and humic acid contents were determined in the asphaltite samples. pH and electrical conductivity (EC) were determined using a glass-electrode pH meter in a solution obtained at a 1:10 soil-to-water ratio, while electrical conductivity was determined using an electrical conductivity device (Richard, 1954). Lime was determined using a Scheibler calcimeter according to the method recommended by Allison and Moodie (1965). Organic matter was determined using the modified Walkley-Black method as recommended by Nelson and Sommers (1996).

To determine raw ash, a porcelain crucible was heated in a muffle furnace at 550°C for at least 30 minutes, cooled to room temperature in a dryer, and weighed to the nearest 0.001 g. A 5 g asphaltite sample was accurately weighed and gradually incinerated in a muffle furnace at 550°C for 4 hours. The porcelain crucible was placed in the dryer, cooled to room temperature, and then weighed again to determine % ash (Jia et al., 2023). The TS 5869 ISO 5073 method used for the determination of humic acid contents of brown coals and lignites. This method determines a) total humic acids (Method A) and b) free humic acids (Method B) in brown coals and lignites by colorimetric method (Anonymous 2003). The method is essentially the same as the Walkley-Black method used in determining organic matter in soil. It is based on the oxidation of the organic portion with chromate and the titration of the remaining chromate. The method is briefly as follows: 0.2 g of the sample is weighed and placed in a 250 mL erlenmeyer flask. 150 mL of sodium pyrophosphate solution is added and mixed. It is heated in a water bath for two hours. After the samples taken from the water bath reach room temperature, pure water is added to the 200 mL line and filtered. The filtered extract is taken and potassium dichromate oxidation solution and concentrated sulfuric acid are added. It is heated in a water bath for 30 minutes. Once it reaches room temperature, it is diluted with distilled water. Three drops of phenanthroline indicator are added and titrated with ammonium iron (II) sulfate solution until the color turns brick red (Özkan, 2008).

## RESULTS AND DISCUSSION

The results of the asphaltite samples used in the study are given in Table 1.

**Table 1. Results of some properties of the asphaltite samples**

Sample No	pH	E.C (mS cm <sup>-1</sup> )	CaCO <sub>3</sub> %	O. M%	Ash%	Humic A. %
A.1	7.69	2.43	37.39	37.96	33	10.22
A.2	7.79	3.09	41.25	35.09	35	6.55
A.3	7.65	2.45	45.15	33.73	33	7.16
A.4	7.46	3.58	23.67	40.05	43.5	9.61
A.5	7.52	3.66	20.38	34.07	43.5	10.52
A.6	7.49	3.21	23.55	32.32	42	9.61
A.7	7.56	2.72	22.21	33.39	35	7.77
A.8	7.57	2.71	18.32	33.26	38	9
A.9	7.57	2.74	23.41	36.18	39.5	9
Min.	7.46	2.43	18.32	32.32	33	6.55
Max.	7.79	3.66	45.15	40.05	43.5	10.52
Mean	7.58	2.95	28.3	38.05	38.05	8.82

When the results obtained in the study were examined, it was determined that the pH values of the asphaltite samples ranged from 7.46 to 7.79. It can be said that it is classified as slightly alkaline. Its electrical conductivity (EC) ranged from 2.43 to 3.66 mS cm<sup>-1</sup>, indicating a salt-free classification. The %CaCO<sub>3</sub> levels of the asphaltite samples were determined to range from 18.32 to 45.15%, while their organic matter contents ranged from 32.32 to 40.05%. Ash content was a minimum of 33% and a maximum of 43.5%. Humic acid contents were lowest in sample A.2 at 6.55% and highest in sample A.5 at 10.52%.

Diskaya and Saltalı (2023) determined the pH and EC of commercially sourced leonardite to be 5.2 and 1.81 mS cm<sup>-1</sup>, while that of gyttja was 7.57 and 0.91 mS cm<sup>-1</sup>. Lime (CaCO<sub>3</sub>) content increased from 8.2% in leonardite to 35% in gyttja. The organic matter content of leonardite was reported as 71%, while that of gyttja was 40%. Akgül et al. (2022) reported the properties of the gyttja they used in their study as pH: 6.76 (1/2), EC: 1970 µS cm<sup>-1</sup>, lime: 34%, organic matter: 43%, and humic acid: 34%. In a study conducted with lignite samples taken from Beyşehir, Ermenek, and İlgın, the humic acid contents of the samples were determined. The Kreulen method was used to determine the humic acid content. Lignite from Beyşehir, Ermenek, and İlgın was found to contain 42% humic acid, while lignite from Ermenek contained 30% and lignite from İlgın contained 38% (Kurbanlı et al. 2002). In this study, the humic acid content of asphaltites from Sirnak province was determined to be low. In a study conducted by Baran et al. (2002) to determine the effect of humic acid on potassium fixation in soils with different clay types, humic acid in the form of K humate (containing 9.5% humic acid), which has a humic acid content similar to this study, was mixed into the soils at various doses; and it was determined that humic acids significantly increased K fixation in the soils.

## CONCLUSION

Sirnak is a province with rich coal deposits. This study aimed to evaluate the agricultural usability of asphaltite, which is widely found and mined in Sirnak. Although its properties, pH, CaCO<sub>3</sub>, and organic matter content suggest its suitability for use in acidic soils, its humic acid content remains well below that of leonardite and gyttja. Further scientific studies and research into its agricultural applicability would be beneficial.

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