

ORGANIC-TAINTED MINERAL SOILS PART I: GEOTECHNICAL TREATABILITY THROUGH NEUTRALISATION DEMAND

CHAN, C. M.^{1*} – ZAINORABIDIN, A.¹ – SANI, S.¹ – SOORIA, S. Z.² – AZIT, R.² – KUEH, H. M.²

¹ *Research Centre for Soft Soils (RECESS), Universiti Tun Hussein Onn Malaysia, Johor, Malaysia.*

² *JKR Centre of Excellence in Engineering & Technology (CREaTE), JKR Melaka, Melaka, Malaysia.*

**Corresponding author
e-mail: chan[at]uthm.edu.my*

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Abstract. Organic-tainted mineral soils (OTMS) occupy an intermediate geotechnical condition between conventional mineral soils and peat: they remain physically workable and potentially suitable for in-situ stabilisation, but reactive organic constituents can consume alkalinity, bind calcium, passivate mineral surfaces and suppress durable cementitious bonding. This critical review defines the geotechnical territory of OTMS and advances neutralisation demand as the governing variable for treatability. Neutralisation demand is defined as the minimum chemical input required overcoming organic acidity and buffering, satisfying initial calcium uptake and establishing a sustained pore-fluid environment favourable to binder hydration and subsequent structural cementation. Evidence from cement-, lime- and alternative cementation systems indicates that treatment response depends on organic reactivity, calcium availability, alkalinity retention, mineralogy, moisture conditions and pore-fluid chemistry rather than organic quantity alone. The proposed framework separates chemical input consumed by organic interference from the binder capacity remaining available for structural strengthening. This distinction explains why conventional binder escalation may produce inconsistent strength development when the underlying chemical demand remains unresolved. The framework further identifies an optimum chemical window between insufficient treatment, where organic interference continues to restrict cementation, and excessive treatment, where adverse chemical and pore-structural effects may initiate deterioration. Accordingly, OTMS treatability should be evaluated through chemical compatibility, sustained binder availability and road-relevant engineering performance rather than fixed organic-content thresholds alone. The proposed neutralisation-first framework provides a mechanism-based basis for distinguishing treatable shallow mineral-organic soils from materials requiring more extensive ground improvement. A companion paper translates this conceptual framework into measurable laboratory criteria, controlled binder comparisons, road-relevant performance verification and field-based acceptance decisions.

Keywords: *reactive organics, binder efficiency, pavement subgrade, chemical conditioning, treatment uniformity*

Introduction

Road construction over weak and chemically variable subgrade requires more than increased binder dosage; it demands a treatment strategy that delivers uniform, moisture-resistant and mechanically reliable support. Cement, lime and blended binders can improve strength, stiffness, compaction and bearing capacity while reducing excavation and imported fill. Their effectiveness, however, depends on sustained soil-binder cementation. This requirement is reflected in Malaysian specifications governing stabilisation, compaction and soaked California Bearing Ratio (Jabatan Kerja Raya Malaysia, 2020; Jabatan Kerja Raya Malaysia, 2018). A critical but often overlooked problem arises in compactable mineral soils containing moderate quantities of reactive organic matter. Common in agricultural land, shallow alluvium, drainage corridors and

heterogeneous fill, these soils may exhibit delayed strength gain, poor binder efficiency and high moisture sensitivity. Humic and fulvic substances consume alkalinity, complex calcium and adsorb onto mineral and cement surfaces, suppressing pozzolanic reactions and C-S-H- and C-A-H-type bonding. Organic-induced strength loss has been reported by Du et al. (2021), while Kang et al. (2017) identified curing-related disruption in cement-treated clay. Further evidence confirms that organic reactivity, rather than total content alone, governs stabilisation response (Shao et al., 2023; Lang et al., 2020). This paper defines organic-tainted mineral soil (OTMS) and proposes a neutralisation-first framework: Quantify chemical interference, satisfy alkalinity and calcium demand, introduce a compatible binder and verify soaked road performance.

The engineering challenge becomes more significant when organic-bearing soils remain sufficiently mineral-dominated to satisfy conventional expectations of compactability but respond unpredictably after chemical stabilisation. In such materials, acceptable grading, moisture-density relationships and initial bearing characteristics may not adequately represent the capacity of the soil to develop durable cementitious bonding. Organic constituents can interfere with stabilisation through several interacting mechanisms, including alkalinity consumption, calcium complexation, adsorption onto reactive surfaces and modification of the pore-fluid environment. Consequently, increasing binder content alone may not produce a proportional improvement in engineering performance because part of the stabilising agent may be chemically consumed or rendered less effective before sufficient soil-binder bonding develops. Previous investigations have demonstrated that organic compounds can inhibit cement hydration and strength development (Shao et al., 2023; Wang et al., 2022; Tremblay et al., 2002), while the effectiveness of treatment also varies according to organic composition, binder chemistry and curing conditions (Luo and Zhang, 2023; Lang et al., 2020). This creates an important gap between conventional soil classification and stabilisation design because the identification of organic matter does not, by itself, establish whether a soil is unsuitable for treatment or whether its chemical interference can be controlled through appropriate conditioning. For road applications, this distinction is particularly important because stabilised subgrade must retain adequate bearing capacity and stiffness under moisture exposure and repeated environmental loading rather than merely achieve satisfactory short-term strength. The variability associated with organic-bearing soils therefore requires a treatment philosophy that considers chemical compatibility before structural strength development. Within this context, OTMS provides an intermediate geotechnical category between conventional mineral soil and highly organic ground, while the proposed neutralisation-first approach provides a mechanistic basis for evaluating whether reactive organic interference can be reduced sufficiently to permit effective binder hydration, durable cementation and reliable road-subgrade performance.

Materials and Methods

This study adopted a structured literature-based conceptual synthesis to establish the characteristics, mechanisms and treatability boundaries of organic-tainted mineral soil (OTMS) for road-subgrade stabilisation. The materials considered were published experimental studies, field investigations, mechanistic studies and engineering specifications addressing organic-bearing soils, cement-and lime-treated soils, alternative binders, organic-binder interactions and road-subgrade performance.

Malaysian road-work specifications were incorporated as the engineering reference for stabilisation, earthwork, compaction and bearing-performance requirements (Jabatan Kerja Raya Malaysia, 2020; Jabatan Kerja Raya Malaysia, 2018). The literature was evaluated according to four principal material domains: soil characteristics, organic characteristics, binder characteristics and engineering response. Soil-related variables included mineralogy, particle composition, moisture-density behaviour, compressibility and physical workability, whereas organic-related variables included total organic content, humic and fulvic substances, acidity and chemical reactivity. Binder-related information covered cement, lime, blended binders and calcium-rich stabilising systems, together with dosage and curing conditions. Particular attention was given to studies demonstrating that organic composition and reactivity influence stabilisation differently even where soils contain comparable quantities of organic matter (Shao et al., 2023; Wang et al., 2022; Lang et al., 2020; Tremblay et al., 2002). Evidence concerning calcium availability, alkalinity and mineral-organic interactions was also examined because these variables directly affect the chemical environment required for cementitious reactions (Konkol and Tisler, 2025; Shabtai et al., 2023; Calero et al., 2023). Studies of organic deposits and mass-stabilised soils were additionally considered to distinguish shallow, mineral-dominated OTMS from peat and highly compressible organic ground for which chemical stabilisation alone may be insufficient (Núñez et al., 2025; Siddiqua et al., 2024; Abdul Azam et al., 2024). This evidence-based classification provided the material basis for defining OTMS as an intermediate treatability domain rather than solely according to a fixed organic-content threshold.

The methodological synthesis was subsequently organised around the proposed neutralisation-first treatment sequence, in which evidence from the selected literature was compared across chemical interference, neutralisation demand, structural cementation and engineering-performance stages. First, reported mechanisms of organic interference were examined to identify processes capable of reducing binder efficiency, including alkalinity consumption, calcium complexation, adsorption onto reactive surfaces, inhibition of hydration-product formation and modification of pore structure. Evidence from cement-, lime- and alternative-binder systems was used to establish whether these mechanisms occurred consistently across different stabilisation approaches (Chen et al., 2025; Joy et al., 2023; Luo and Zhang, 2023; Cao et al., 2023; Ma et al., 2016; Harvey et al., 2010). Second, the evidence was interpreted in terms of neutralisation demand, defined conceptually as the chemical requirement that must be satisfied before sufficient active binder remains available for durable structural cementation. Reported relationships among humic-acid concentration, stabiliser consumption, pH and strength development were used to support this interpretation (Ma et al., 2018; Mohd Yunus et al., 2013; Onitsuka et al., 2003). Third, treatment effectiveness was assessed using engineering responses relevant to road subgrades, including strength, soaked bearing performance, stiffness, moisture susceptibility, durability and treatment uniformity. Particular consideration was given to evidence concerning resilient behaviour and wetting-drying deterioration (Owusu et al., 2025; Ackah et al., 2024; Hoy et al., 2023; Syed et al., 2023). Finally, evidence of adverse responses at excessive chemical dosages was synthesised to establish an optimum chemical window and conceptual treatability boundary rather than assuming continuous improvement with increasing stabiliser content (Zhang et al., 2026; Joy et al., 2025; Horpibulsuk et al., 2013). The resulting framework integrates material classification,

chemical compatibility and engineering verification into a sequential basis for evaluating OTMS treatment suitability.

Results and Discussion

The intermediate ground category

The geotechnical boundary of organic-tainted mineral soil (OTMS) must be clearly distinguished from both conventional mineral subgrade and unsuitable organic ground. Routine earthwork assessment commonly separates usable mineral soils from topsoil, peat, highly organic deposits and excessively soft materials. This binary approach may overlook an intermediate condition: Mineral-dominated, physically compactable soil containing sufficient reactive organic matter to impair stabilisation (*Figure 1*). Figure 1. The Intermediate Ground Theory illustrating (A) comparison of conventional and OTMS domain assessment, and (B) negative geotechnical implications from organic heterogeneity. OTMS may retain a recognisable sand-silt-clay grading, measurable maximum dry density and optimum moisture content, and an apparently coherent mineral fabric. These properties can suggest that lime or cement treatment is feasible. Yet the organic fraction may alter water retention, pore-fluid chemistry, interparticle contact and binder-mineral interaction without materially changing visual appearance or routine index properties. Shao et al. (2023) showed that different organic constituents produce distinct effects on strength, deformation and soil structure, confirming that total organic content alone cannot predict stabilisation response. Such soils may arise from topsoil intrusion, decomposed root matter, organic-bearing alluvium, floodplain deposits, drainage corridors or contaminated excavated fill. Although far less organic than peat, they may still exhibit delayed hardening, reduced shear strength, poor stiffness recovery and high binder sensitivity. Konkol and Tisler (2025) demonstrated that calcium availability markedly altered the response of stabilised organic silt, underscoring the importance of binder chemistry. For road infrastructure, this variability is critical because the treated subgrade must function as a continuous load-transfer platform. Local changes in organic content, moisture, mineralogy and treatment depth may create weak zones despite acceptable average properties. Huang et al. (2023) similarly linked higher humic-acid content to weaker particle contacts, greater porosity and reduced cemented strength. OTMS should therefore be regarded as a geotechnical treatability domain requiring targeted chemical conditioning before reliable structural cementation can occur.

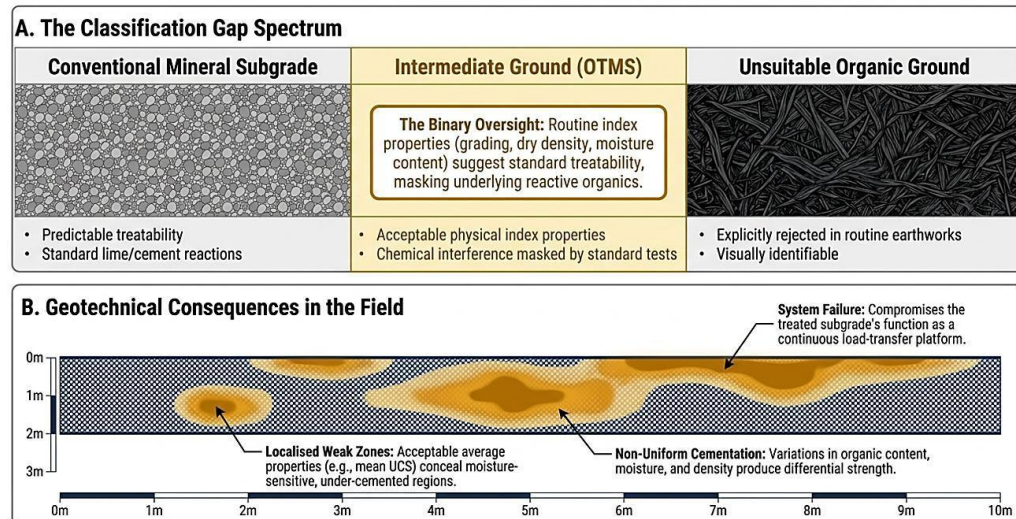


Figure 1. The Intermediate Ground Theory illustrating: (A) comparison of conventional and OTMS domain assessment, and (B) negative geotechnical implications from organic heterogeneity.

Distinction from peat and highly organic deposits

OTMS is not a substitute label for peat. Peat is organic-dominated, highly compressible and typically characterised by fibrous fabric, very high water content, low dry density and poor bearing capacity. Its response is governed largely by consolidation and creep, such that embankment performance may remain settlement-controlled despite local strength improvement. Siddiqua et al. (2024) further showed that organic deposits can vary markedly in strength, stiffness and compressibility. By contrast, OTMS remains mineral-dominated, exhibits a conventional moisture-density response and occurs within a shallow, workable layer suitable for in-situ treatment. Its principal limitation is chemical interference with binder hydration rather than deformation of a thick organic deposit. The material must also retain a credible prospect of meeting compaction, soaked bearing capacity, stiffness and durability requirements. This distinction is essential because chemical hardening cannot eliminate foundation-scale deformation. Peat behaviour remains closely linked to compressibility and fabric (Abdul Azam et al., 2024), while mass-stabilised organic clay is influenced jointly by binder dosage, preload and final porosity (Núñez et al., 2025). Accordingly, deposits governed by fibrous structure, excessive moisture or deep compression fall outside the OTMS framework and require deeper ground-improvement solutions. OTMS is therefore a geotechnical treatability category for shallow mineral soils requiring pretreatment before reliable cementation.

Organic quantity does not define organic interference

OTMS treatability cannot be determined by organic percentage alone. Loss on ignition and total organic carbon quantify the organic fraction but do not reveal its chemical form, reactivity or effect on binder hydration. Tremblay et al. (2002) showed that soils with similar organic contents may develop markedly different cemented strengths because their organic compounds interact differently with stabilisers. Organic content is therefore a screening indicator, not a definitive treatment criterion. Humic and fulvic substances are especially disruptive because they promote acidification, surface

adsorption and calcium complexation. Wang et al. (2022) linked fulvic-acid-induced strength loss to these combined mechanisms, while Luo and Zhang (2023) confirmed that geopolymer binders also remain vulnerable. The controlling factor is thus the chemical demand imposed on the soil-binder system. A modest concentration of highly reactive organics may consume more alkalinity, immobilise more calcium and retard cementation more severely than a larger quantity of relatively inert residue. Calcium-mediated sorption further reduces the calcium available for C-S-H- and C-A-H-type formation (Shabtai et al., 2023). Mineralogy compounds this variability because clay type, surface area, charge and cation-exchange capacity govern organic adsorption and binder accessibility (Calero et al., 2023). OTMS assessment should therefore integrate organic reactivity, equilibrated pH, buffering capacity, calcium demand, mineralogy, moisture, binder chemistry and curing. As Zhao and Wong (2025) emphasised, cement-soil behaviour reflects interacting material and process variables. The treatment boundary should consequently be defined by the onset of measurable binder inefficiency, providing the basis for determining neutralisation demand before binder selection.

Geotechnical consequences and the classification-treatment gap

The chemical variability of OTMS affects the full stabilisation cycle. During construction, elevated moisture demand, poor pulverisation and irregular compaction may combine with variations in organic content, density and treatment depth to produce non-uniform cementation. As illustrated in *Figure 2*, conventional mineral soils generally permit direct binder-mineral interaction, whereas OTMS introduce coupled chemical and physical disruptions that restrict hydration, particle bonding and strength development. Ackah et al. (2024) showed that subgrade strength depends jointly on moisture content, dry density, binder dosage and curing; in OTMS, organic heterogeneity adds another source of uncertainty, allowing acceptable mean values to conceal localised weak zones. During curing, OTMS may develop delayed setting, incomplete particle bonding and high residual porosity. Increasing cement dosage can improve average UCS without eliminating under-cemented or moisture-sensitive regions. This is critical because stabilised subgrade performs under repeated traffic and fluctuating moisture rather than dry monotonic loading. Wetting-drying cycles can weaken cementitious bonds, modify pore structure and reduce resilient modulus, as demonstrated by Hoy et al. (2023) and Owusu et al. (2025). Prolonged fulvic-acid exposure may also promote decalcification and connected porosity, allowing organic interference to persist as a durability mechanism (Cao et al., 2023). The consequences include reduced soaked CBR, stiffness loss, pumping, permanent deformation, differential support, rutting and cracking.

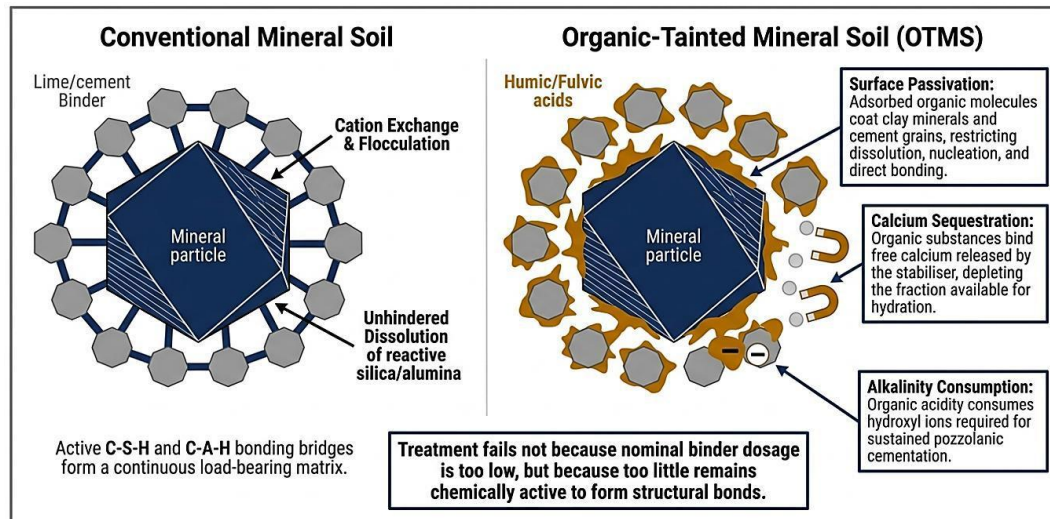


Figure 2. Coupled Mechanistic Disruption in OTMS Stabilisation-comparison between conventional mineral soils and OTMS.

Assessment should therefore extend beyond dry UCS to soaked CBR, resilient modulus, moisture durability, volumetric stability and treatment uniformity, supported by realistic field validation, as emphasised by Syed et al. (2023). These risks expose a critical gap between soil classification and binder design. Routine testing may identify OTMS as mineral-dominated and quantify organic content, yet it cannot establish whether the organic fraction will consume alkalinity, complex calcium or inhibit long-term cementation. Conversely, failure of cement-only treatment may reflect unresolved chemical demand rather than intrinsic untreatability. The OTMS framework therefore introduces a formal chemical-treatability stage before structural stabilisation. Treatment should proceed only where the soil remains workable, organic interference can be quantified, practical neutralisation demand established, binder-compatible alkalinity sustained and durable cementation verified. The central question thus shifts from how much cement is required to what chemical condition must first be created for reliable cementation.

Mechanistic basis of neutralisation demand

OTMS cannot be treated simply as weak soil requiring more binder. Its behaviour is governed by interactions among the mineral skeleton, reactive organics and pore fluid, which determine how much stabiliser remains available for cementation. The paper therefore distinguishes two functions: (1) Satisfying the organic chemical demand, and (2) developing the cementitious structure required for durable geotechnical performance.

Coupled disruption of cementitious strengthening

In conventional mineral soil, cement hydration forms calcium silicate hydrate and calcium aluminate hydrate phases that fill pores, bridge particles and increase stiffness and strength. Lime promotes cation exchange and flocculation, while sustained alkalinity dissolves reactive silica and alumina for longer-term pozzolanic cementation. Both mechanisms depend on available calcium, sufficient hydroxyl ions, accessible mineral surfaces, moisture and favourable curing conditions. Reactive organic matter

disrupts these requirements concurrently. Carboxylic and phenolic groups in humic substances bind calcium, organic acidity consumes hydroxyl ions, and adsorbed organics coat clay minerals and cement grains, restricting dissolution, nucleation and bonding. Harvey et al. (2010) linked natural organic matter to reduced C-S-H formation in lime-stabilised smectite, while Ma et al. (2016) showed that humic acid suppressed hydration-product development and consumed part of the binder capacity. The impairment may also persist beyond early curing: Joy et al. (2023) observed limited later strength development as pH declined, and Chen et al. (2025) found progressively inhibited calcium-carbonate precipitation with increasing humic-acid concentration. Organic interference should therefore be understood as a coupled chemical demand involving calcium binding, alkalinity consumption, surface passivation and water retention. Delayed hardening does not necessarily indicate eventual complete cementation; strength development may cease once the chemical environment can no longer sustain binder reactions. Conventional treatment may consequently fail not because the nominal binder dosage is too low, but because too little remains chemically active to develop a continuous, durable load-bearing matrix.

Neutralisation demand as the governing design variable

This paper advances neutralisation demand as the central variable governing OTMS treatability. It denotes the minimum chemical input required to overcome organic acidity and buffering, satisfy initial calcium sequestration and establish a sustained pore-fluid environment favourable to binder hydration. The concept separates the treatment consumed by organic interference from that remaining to develop cementitious bonding and engineering strength. As conceptualised in *Figure 3*, OTMS treatment therefore involves a two-stage chemical transition: initial consumption of the organic neutralisation demand, followed by structural cementation within an optimum chemical window bounded by insufficient treatment and deterioration. Supporting this distinction, Ma et al. (2018) quantified increasing stabiliser consumption in humic-acid-bearing clay, showing that part of the treatment may be depleted before effective cementation begins. Neutralisation demand extends beyond total organic content and immediate pH. Loss on ignition and total organic carbon quantify organic matter but do not indicate its acidity, calcium-binding capacity or ability to passivate reactive surfaces. In Ariake clay, humic acid suppressed pozzolanic-product formation and reduced the strength of lime-treated soil, whereas increased salt concentration moderated this interference (Onitsuka et al., 2003). Mohd Yunus et al. (2013) similarly observed marked deterioration beyond a material-specific humic-acid threshold, demonstrating that stabilisation may decline disproportionately once organic demand exceeds the available chemical capacity. A high initial pH confirms only temporary alkalinity; it does not establish whether the condition will persist after equilibration or whether sufficient reactive calcium remains available. Cao et al. (2023) found that ultra-fine cement improved hydration-product formation and reduced macroporosity in humic-acid-containing soil, but the benefit diminished beyond the optimum dosage. Greater binder reactivity may therefore offset organic interference without resolving its underlying chemical demand.

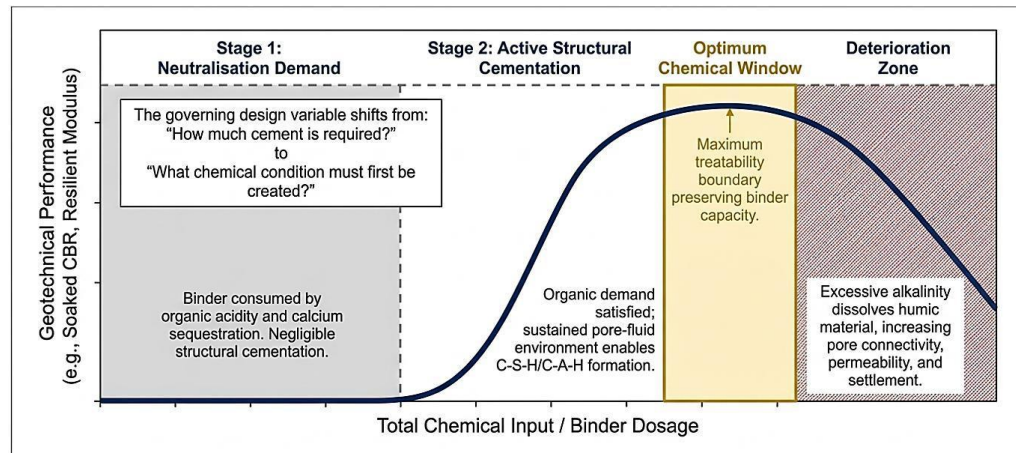


Figure 3. The Neutralisation Demand Framework for OTMS—a two-stage chemical transition involving: (1) organic demand consumption and (2) structural cementation bound by an optimum chemical window and deterioration zone.

Optimum chemical window and treatability boundary

Neutralisation must not be equated with maximising alkalinity or calcium addition. Zhang et al. (2026) showed that strongly alkaline conditions can promote cementitious-phase formation while simultaneously dissolving humic material, increasing pore connectivity, permeability and settlement. Horpibulsuk et al. (2013) identified a comparable dosage boundary in calcium-carbide-residue-fly-ash stabilisation, where strength development progressed through active, inert and deterioration zones. Calcium-rich treatment therefore operates within an optimum chemical window rather than improving continuously with dosage. Joy et al. (2025) demonstrated this dosage sensitivity in lime-treated organic-rich marine clay. Moderate sodium-chloride addition improved calcium availability, particle interaction and long-term strength, whereas a higher dosage induced dispersion and restricted hydration. Although the reported dosages are not transferable directly to OTMS, the case confirms that effective conditioning is material-specific and governed by competing beneficial and adverse reactions. The treatability boundary shown in *Figure 3* consequently represents the point beyond which additional chemical input no longer produces proportional geotechnical benefit and may instead initiate deterioration. Neutralisation demand consequently offers a more defensible treatment basis than fixed organic thresholds or empirical binder escalation. It determines whether organic interference can be controlled at a practical dosage without causing adverse pore-structural, volumetric or environmental effects, while preserving sufficient binder capacity for durable cementation. Soils requiring excessive treatment, failing to sustain binder-compatible chemistry or remaining governed by deep compressibility and decomposition fall outside the framework. The governing question therefore shifts from how much binder should be added to what chemical condition must first be established for reliable geotechnical performance.

Conclusion

This critical review establishes organic-tainted mineral soil (OTMS) as an intermediate geotechnical treatability category between conventional mineral subgrade and peat or highly organic ground. The distinction is important because OTMS remains

mineral-dominated, physically workable and potentially suitable for in-situ stabilisation, yet its engineering response may be controlled by reactive organic constituents that are not adequately represented by total organic content alone. The reviewed evidence demonstrates that humic and fulvic substances can consume alkalinity, complex or sequester calcium, adsorb onto mineral and binder surfaces and restrict the formation of cementitious products, thereby reducing binder efficiency and delaying or limiting strength development (Shao et al., 2023; Wang et al., 2022; Tremblay et al., 2002). Mineralogy, pore-fluid chemistry, moisture condition, binder composition and curing further modify these interactions, confirming that apparently similar organic-bearing soils may exhibit substantially different stabilisation responses (Zhao and Wong, 2025; Konkol and Tisler, 2025; Calero et al., 2023). Consequently, conventional classification based primarily on index properties, organic percentage or short-term strength may not adequately determine whether an organic-bearing mineral soil is chemically compatible with stabilisation. The proposed neutralisation-demand concept addresses this limitation by separating the chemical input consumed in satisfying organic acidity, buffering and initial calcium sequestration from the binder capacity remaining available for structural cementation. Evidence of stabiliser consumption, inhibited hydration and reduced cementitious-product formation supports this mechanistic distinction (Chen et al., 2025; Ma et al., 2018; Ma et al., 2016; Harvey et al., 2010). OTMS treatability should therefore be governed not simply by how much organic matter is present or how much binder is added, but by whether a sustained chemical environment can first be established in which sufficient active calcium, alkalinity and accessible mineral surfaces remain available for durable soil-binder interaction.

The neutralisation-first framework further demonstrates that successful OTMS treatment requires an optimum chemical window rather than unrestricted escalation of binder, lime or calcium-rich additives. Insufficient treatment leaves organic chemical demand unresolved and restricts structural cementation, whereas excessive chemical input may introduce adverse reactions, including organic dissolution, particle dispersion, increased pore connectivity and deterioration of volumetric or mechanical performance. Recent evidence supports the existence of such material-specific dosage boundaries and demonstrates that increased chemical input does not necessarily produce proportional geotechnical improvement (Zhang et al., 2026; Joy et al., 2025; Horpibulsuk et al., 2013). Accordingly, the treatability boundary should represent the practical condition at which organic interference can be sufficiently controlled while maintaining binder-compatible chemistry and avoiding detrimental pore-structural, volumetric or environmental responses. Engineering verification must subsequently extend beyond dry unconfined compressive strength because road subgrades operate under variable moisture conditions, repeated loading and environmental exposure. Soaked bearing capacity, resilient response, wetting-drying durability, volumetric stability and treatment uniformity therefore provide essential complementary indicators of whether chemical conditioning has translated into reliable structural performance (Owusu et al., 2025; Ackah et al., 2024; Hoy et al., 2023; Syed et al., 2023). The framework does not imply that all organic-bearing soils are chemically treatable; deposits dominated by fibrous structure, excessive moisture, deep compressibility or persistent decomposition remain outside the OTMS domain and may require alternative ground-improvement strategies (Núñez et al., 2025; Siddiqua et al., 2024; Abdul Azam et al., 2024). Overall, this review shifts stabilisation design from empirical binder escalation toward mechanism-based chemical compatibility, providing a conceptual

basis for identifying OTMS, determining neutralisation demand and defining an optimum treatment window. The companion study should translate these concepts into measurable laboratory thresholds, controlled treatment procedures, road-relevant performance criteria and field-validation protocols.

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Conflict of interest

The authors declare that they have no commercial, financial, or personal relationships that could be perceived as influencing the research or its publication.

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