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ISS

IONIC SOIL STABILIZER

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-Merkezi Süpürge Sistemi.
-Su Arıtma Sistemleri.
-Isı Pompası Sistemleri.
-Yerden Isıtma Sistemi.

-ISS 2500 Toprak Stabilizatörü
-Kaydırmaz sülüsyon.

www.eraslanekonomi.com

ISS 2500 IONIC SOIL STABILIZER®

A basic overview and its advantages to you and your community

Overview

ISS 2500 is manufactured in South Africa by Road Material Stabilisers (Pty) Ltd and has been used by institutional and private bodies in many parts of the world for over twenty two years. As one of the biggest costs to an authority is its road infrastructure – the maintenance of existing roads and the upgrading or construction of new roads, more cost-effective methods and materials are becoming essential in order to attain the necessary goals and service delivery. This also holds true for housing developments as the cost of the internal road structures often forces up the price of stands or houses.

ISS and its use

When designing a road of any category, one of the first things the designing engineer must look at is the in-situ conditions and available construction materials. Often the biggest problem in the selection of a suitable material for road construction is its corresponding clay content, as a material with even a small amount of an active clay mineral content can cause this material to be unsuitable or have insufficient strength for its intended use. In cases such as these, suitable materials must be sourced from a borrowpit as close to the intended site as possible. The cost of these materials and even more so their transportation is often expensive. Alternatively, the method of correcting clayey materials for road construction can be with the use of road lime but this is both bulky and expensive. ***ISS*** is specifically designed to treat these substandard or marginal materials by reacting with the clay particles within these soils and altering their clay-water relationship and rendering these previously unsuitable material suitable.

Advantages

As ***ISS*** is treating the clay within the soil at a particle level, only a very small quantity per m^2 is required. One 210 Litre drum of ***ISS*** is sufficient product to treat 7 000 m^2 (for a standard 150-200 mm layer) and is the equivalent of 60 to 80 tons of an alternative stabiliser. With ***ISS***, there is far greater use of the in-situ materials and the costly exercise of excavating and transporting borrowpit materials is largely eliminated. As the cost of ***ISS*** is far lower, it allows many more kilometres of road to be built with the same budget or, alternatively, as far less is spent on the layer works of the road, more money can be utilised for a seal or accompanying work (drainage mechanisms, kerbstone, pavements, etc).

Where suitable gravels exist, the treatment of these materials with ***ISS*** minimises deterioration or problems should penetration of water beneath the seal occur. Should potholes, etc occur with an ***ISS***-treated road, the integrity of the road foundation remains intact and maintenance and repair work is localised or restricted to that of the seal.

Unlike conventional stabilisers, there is no working period or time limit when processing a layer with ***ISS***. This adds a further potential cost saving to users during the rainy season or in the event of machinery downtime.

Construction/application

The application of ***ISS*** requires no specialised machinery and only standard road construction equipment is used. No special technique is required and the standard method for the construction of a gravel layer is followed. Additionally, it is Road Material Stabilisers policy to provide off-site technical assistance in establishing the suitability of ***ISS*** for a particular design and available materials. Furthermore, on-site technical assistance is provided to ensure that the road builder is familiar with the ***ISS*** application method.

The standard application rate for ***ISS*** is 0.2 L/m^3 and the required equipment is a water truck, motor grader and compactor/roller. With this equipment, a production rate of ±2 500 m^2 per day is usually achieved. However, in narrow township roads, the production rate can fall due to the difficulty the grader has in turning. In these cases, a disc plough is helpful to speed up the production rate.

ISS is applied by the same method for a sealed or gravel road. If the stabilised layer is to be used as a wearing course in the design, then adequate drainage must be provided for to ensure maximum benefit is achieved from the reconstruction and stabilisation. Should a seal on top of an ***ISS*** layer be required, there are many to choose from. However, when stabilising with ***ISS***, the base course integrity does allow for a much cheaper seal to be selected, e.g. chip and spray, sand seal.

ISS uses

There are two main uses for ***ISS***: (1) the treatment of the wearing course material for a gravel road, and (2) the treatment and stabilisation of road layer works of a sealed (tarred) road.

1. *Unsealed road*: With an unsealed road, a wearing course material needs to be selected that contains a certain amount of clay to assist in binding the material. ***ISS*** neutralises the negative aspects of this clay content and allows far greater densities to be achieved with the same material. This higher density results in a greater resistance to abrasion lowering material loss at the surface and reducing dust.
   The ***ISS***-treated layer does not absorb water and thus mud and other associated wet weather problems are not present during the wet season. Because of this, the required maintenance of the road is greatly reduced (often eliminated), thereby creating a substantial cost saving to the road authority.
   The life of an unsealed ***ISS*** road would be dependent on the material, traffic type and volume and design (the provision of adequate drainage is essential).
2. *Sealed road*: With a sealed road, the main requirement for the selection of a suitable material is its bearing capacity. Materials with a clay content have a tendency to absorb water after compaction, resulting in a low bearing capacity. As ***ISS*** corrects this problem, these materials retain their compacted density and become suitable. As treatment with ***ISS*** is permanent, the only required maintenance to an ***ISS***-sealed road is that of the seal.

Conclusion

As each particular area and/or authority have their own specialised requirements and needs, the above information would need to be further tailored taking individual situations, requirements and available budgets into account.

USE ISS TO GET 75% MORE ROAD FOR YOUR MONEY!

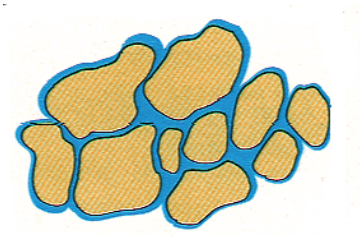
WHAT IS *ISS*?

ISS 2500® ***Ionic Soil Stabilizer®*** is a water-soluble chemical used in the construction of all types of roads utilising in-situ materials. It is 100% organic and is derived from combined organic sulphur and buffered acids that are combined as bi-sulphates. ***ISS*** is a true catalyst, it is not consumed in its function but continues and perpetuates its action as long as water is present. ***ISS*** is non-toxic in diluted form and poses no threat to groundwater supplies or flora and fauna.

ISS 2500 is an economical construction method for all types of roads, parking areas, by-passes, airfields and foundations.

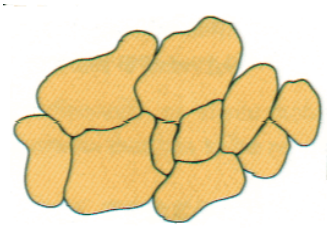
Stabilising with ***ISS*** improves the physical and mechanical characteristics of soils. Field and laboratory tests show that the increase found in layer strength is not only due to compaction, but is also due to the improvement of material properties such as PI, grading modulus and linear shrinkage.

HOW ISS WORKS



Normal soil

VOIDS:
Capillary water trapped in thepores between the soil particles.



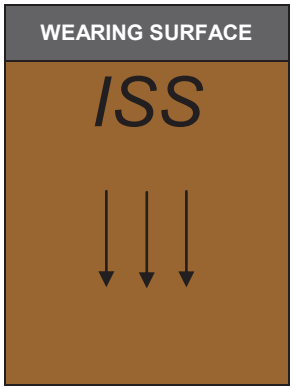
***ISS* –treated soil**

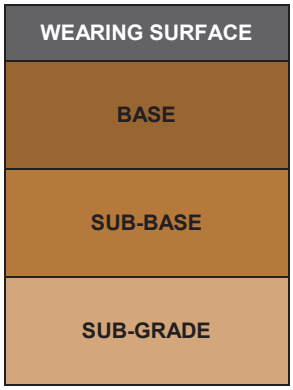
NO VOIDS:
ISS releases the Water held in the soil, thus eliminating all voids.

ISS permanently alters the soil allowing maximum compaction and preventing the reabsorbtion of water. Treatment with ISS releases the adsorbed water from the soil particles, minimising the voids and allowing the particles to be compacted to much greater densities thereby increasing the shear strength and bearing capacity of the layer. Treatment with ISS is permanent and the compacted layer has a high density and high load bearing capacity and is unaffected by extreme climatic conditions.

WHERE *ISS* IS USED

ISS is used in base, sub-base and sub-grade materials.





With ***ISS*** you can achieve the required density with soil that is normally discarded. There is no need to strip and haul this material away. The expense of removing materials and replacing them with costly borrowpit materials can be completely avoided when using ***ISS***.

Therefore, on average, up to 75% of the cost of road construction by methods hitherto employed (ie without ***ISS***) can be saved.

This means that, instead of building 1 km of road (or similar paved surface) you can now, for the same money, build 2, 3 or even 4 km with ***ISS***!

SOIL TYPES THAT WORK WITH ISS

ISS works with most soils encountered in road construction but soil testing is recommended. ***ISS*** works in soil types: A-2-4, A-2-6, A-4, A-5, A-6 and A-7. In addition, the soil should have a PI with a minimum of 10% of the soil particles passing through the 0,075 mm (#200) sieve (see *Soils Table*).

INTRODUCTION TO ELECTROCHEMICAL STABILISATION

This introduction is not intended as a detailed explanation but merely serves to give a fundamental understanding of ***ISS*** and the effect it has on a large number of soil types.
Soil stabilisation can be divided into four main classifications:

1	Physiomechanical	:	Compaction
2	Granulometric	:	Mixture of soils
3	Physiochemical	:	Cement, lime, asphalt
4	Electrochemical	:	***ISS 2500 Ionic Soil Stabilizer***

Action of *ISS* on soil particles

The fine particles of clays and silts, due to their mineralogical composition have an excess of negative ions (anions) and therefore attract positive ions (cations) of water, making this water adhere to them to form pellicular water. This clay is unsuitable for construction as the adsorbed water acts as a lubricant on the soil particles thus preventing compaction of the soil.

ISS, by its chemical composition, has an enormous potential ionic exchange capacity. When small quantities of ***ISS*** are added to water, they activate the ions H^+ and $(OH)^-$, ionising the water which then vigorously exchanges its electrical charges with the soil particles forcing the pellicular water to break its electrochemical bond with the soil particles to become free water which can then drain from the soil through gravity or evaporation.

This electrochemical reaction of ionic exchange is permanent and irreversible.

Once the pellicular water separates from the fines in an irreversible electrochemical process and drains as free water, the soil particles settle and align themselves in such a way that they attract each other. A higher densification of the soil mass is achieved eliminating all the voids.*

* See *How ISS functions as an ion exchanger ...*

PLASTICITY

Plasticity Index is used to describe the condition where clays exist. It is common practice to discard densely graded bases with a PI in excess of 6. There are some exceptions to the rule that the higher the PI of the clay, the more difficult it is to stabilize. However, it is almost universally believed that clays can only be improved by reducing the plasticity index.

In order to understand PI, let us define it. **Plastic limit** denotes that percentage of moisture by weight that must be added to dry clay in order to cause it to begin to lose its coefficient of friction and, instead, to be bound together by the cohesiveness of thin films of water. **Liquid limit** is the percentage of moisture that must be added to dry clay in order to cause it to flow at a certain rate because of the increased thickness of the water film between adjacent soil particles. The difference between them is the **plastic index**.

It should be borne in mind that only clays on or near the surface of the earth are free to exhibit these characteristics. When under compression, because of other soil, base material, paving or overburden, or because of mechanical compactive effort, or both, clay cannot absorb much water in excess of that required to fill the voids that exist between the particles. Therefore, except for those clays found on the shoulders and slopes and in the ditches along the right-of-way, clay that is normally encountered during road building operations is not subject to the physical laws by which plasticity index is determined.

PI is usually reduced by adding sand or other granular material, lime or cement. While some chemical reactions do occur in the soil when lime or cement is added, they perform essentially the same function as sand, that of reducing the proportion of the particles possessing colloidal or surface active characteristics. Finely divided clays have both. Sand has neither.

Lime or cement must be added to clay at a rate of at least 6% by weight if significant practical results are to be obtained. Often higher rates are needed, and there are clays that cannot be satisfactorily stabilized regardless of the amount used.

Where sand or other granular material is used, the amount added must be from a minimum of 10 to as high as 50%. These massive quantities of lime, cement or sand increase bearing values and improve the internal drainage of the clay. While PI is also reduced, it is actually only a measuring guide. It is the fact that bearing values are higher and that internal drainage is improved so that soft spots and frost lensing do not occur.

There are some chemical formulae that will reduce PI drastically. Unfortunately, they also reduce the bearing values of clays. To use a chemical that would reduce the PI of a clay from 20 to 6 while also reducing the CBR from 10 to 5 would obviously be foolish. Therefore, the statement that is sometimes made in regard to clay that the only thing of importance is to reduce the PI is completely unfounded.

***ISS 2500®* *Ionic Soil Stabilizer®* will, when used in accordance with instructions, increase the bearing values and reduce the moisture content permanently. It also, to some extent, reduces the PI. However, it should be kept in mind that, with this system of stabilization, it is possible to correct the problems of clays without reducing the PI to the same extent as would be necessary when using the other methods described above.**

It has been said that, to treat a clay soil primarily for the purpose of reducing the PI, is like trying to cure a fever instead of the disease that is the cause. The afflictions of clays are low bearing values when wet and poor moisture equilibrium. When these are properly treated to the level required in base or sub base with ISS 2500, the plasticity index that results is only a statistic.

How ISS 2500 functions as an ion exchanger and how it acts upon colloidal particles during application

In general in soil mechanics, it is usual to draw a distinction between two phenomena of water: static water and water in motion. The latter in particular (where the motion is caused by penetration or by the action of gravity) greatly helps accelerate many reactions initiated by treatment with ISS 2500. Static water, though it does not move under the actions of gravity, is nevertheless not completely motionless. Generally speaking, the motion caused by osmotic forces or molecular movement is very slight but, over a long period of time, considerable masses of water may nevertheless be transported as a result of this ! either as a liquid or as a gas (evaporation). Static water remaining in the soil can be subdivided into four categories differing from one another chiefly in the order of magnitude of the force with which they adhere to the soil particles.

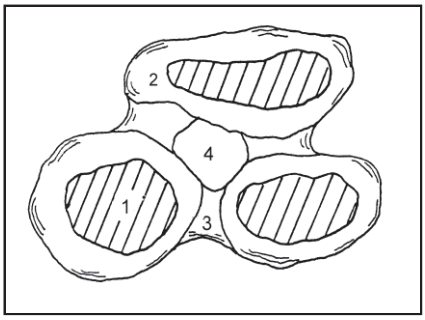


Figure 11
1. Chemical water, incorporated in the crystal structure of the soil minerals.
2. Adsorbed water, which is held on the surfaces of the soil particles.
3. Water which is held by surface tension at the points of contact of the soil particles.
4. Capillary water in the pores between the soil particles.

With the exception of chemically combined crystalline water, all the above-mentioned types of water are involved in the ISS 2500 reaction process. Since the main function of ISS is to reduce the amount of water held in the soil in order to form voids for optimum compaction and, alternatively, to decrease the swelling capacity of the individual soil particles, the characteristics of these various categories of water in the soil will now be briefly discussed.

Chemical water

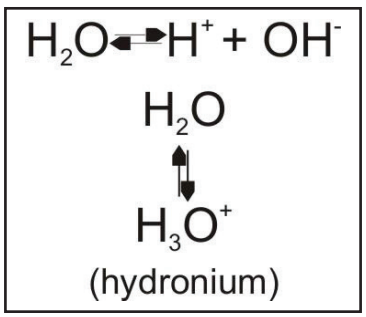
This water, which is incorporated in the crystal structure and thus chemically combines with the soil minerals, forms only a very minor proportion of the water in the soil. It cannot be expelled from it by drying with temperatures above 110EC. From the technical construction point of view, this water can be regarded as an integral constituent of the soil itself and can be ignored in construction.

Adsorbed water

Water adhering to the surface of the soil particles can be partly, but not entirely, driven out by drying in an oven. When soil dried in this way is allowed to cool, it will reabsorb water in amounts dependent on the humidity of the ambient air.

Water held by surface tension

Most of the water retained in soils is derived from water which has been held by surface tension at the points of contact between particles or which otherwise can move as pore water or as free water in the capillaries and larger voids.

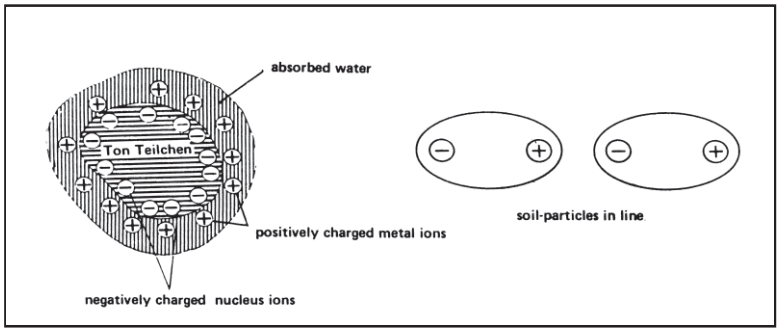


Capillary water

This is water lodged in the pores between the soil particles; it can be partly or entirely removed by seepage, evaporation or water extraction with suitable equipment.

The most difficult problem is raised by the *adsorbed water* which adheres to the whole surface of the soil particle and almost forms part thereof. This film of water enveloping the particles, which ultimately governs the expansion and shrinkage of colloidal soil constituents, cannot be completely eliminated by purely mechanical methods. **However, by means of temperature effects and the addition or removal of water** with mechanical pressure, it is possible to vary the amount of water held in this manner. Such variations are

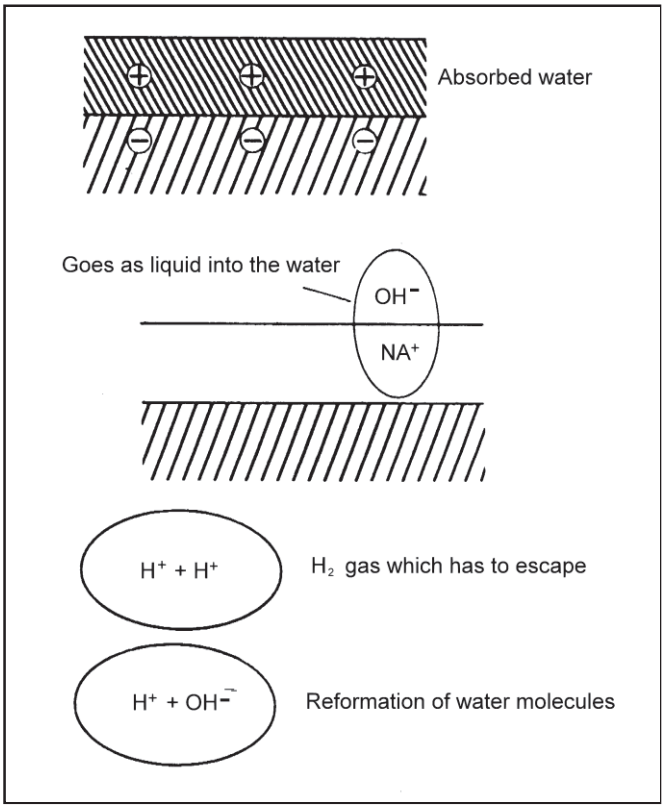
attended by swelling or shrinkage. This provides an ideal point of operation for ISS 2500. To obtain a better understanding of this, the principle on which the action of ISS 2500 is based will be explained. In this context, the electrostatic characteristics of soil particles will also have to be considered. As a result of a lowering of the dipole moment of the water molecule, there occurs dissociation into an hydroxyl (!) and a hydrogen (+) ion.



The hydroxyl ion in turn dissociates into oxygen and hydrogen, while the hydrogen atom of the hydroxyl is transformed into a hydronium ion. The latter can, in the nascent state, accept or reject positive or negative charges, according to circumstances.
Normally, the finest colloidal particles of soil are negatively charged. The enveloping film of absorbed water contains a sufficient number of positively charged metal ions ! such as sodium, potassium, aluminium and magnesium ! which ensure charge equalisation with respect to the electrically negative soil ion.

Absorbed or hydroscopic water

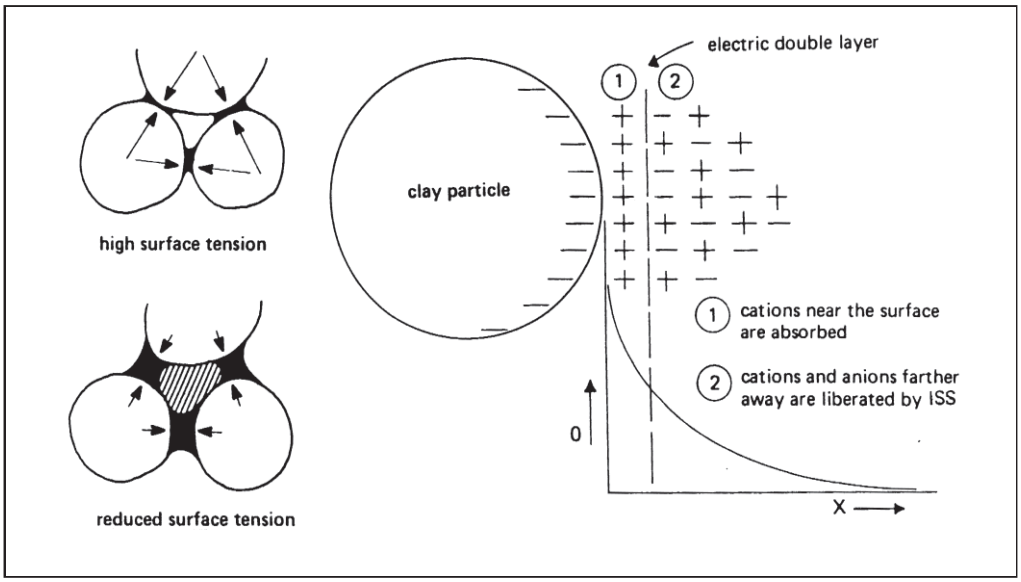
Absorbed or hydroscopic water is, as already stated, mainly responsible for the swelling and shrinking properties of soils. A soil particle comprising only chemically combined water cannot swell, ie it cannot alter its structural density. Only the film of absorbed water adhering firmly to the particle surface can expand in volume as a result of further water absorption when the soil is wetted. This effect is more particularly prominent in fine-grained soils, such as clays. Since this absorbed water is held in a "stable" form on the clay particles, thickening of this water film will involve a displacement of the centres of the particles toward one another with the overall effect that the volume of the mass of soil increases. Therefore, in order to achieve the densest possible packing of the clay particles and to obviate the undesirable swelling and shrinking behaviour of such soil, it is necessary merely to reduce the thickness of the water film (which, as has already been pointed out, is held very firmly to the particles) or to break the film. The only possible way to do this economically and permanently is by ion exchange. Because of its electrokinetic properties, the ISS 2500 solution acts upon the positive and the negative charges of the soil particles. The effects of this action are threefold:



1. The film of the absorbed water is greatly reduced and in fact entirely broken.
2. The soil particles acquire a tendency to agglomerate.
3. As a result of the relative movement, the surface area is reduced and less absorbed water can be held thereby, so that this in turn reduces the swelling capacity. Moreover, these three factors facilitate compaction of the soil or indeed make it in fact possible.

In bringing about this phenomenon, the positive charges of the hydronium ion or of the negatively charged hydroxyl ion will normally combine with the positive charge to exert adequate pressure on the positively charged metal ions in the absorbed water film. As a result of this, the existing electrostatic potential barrier is broken. When this reaction occurs, the metal ions migrate into the free water which can be washed out or removed by evaporation. Thus the film of absorbed water enveloping the particles is reduced. The particles thereby lose their swelling capacity and the soil as a whole acquires a friable structure. This is an irreversible process.

The hydrogen ions which are liberated in the dissociation of the water molecules can once again react with free hydroxyl ions and form water along the gaseous hydrogen. It is important to note that the moisture content of the soil affects the surface tension and is thus a factor affecting compaction. It should furthermore be pointed out that dry soil is poorly suited for compaction only because of the surface tension of the water contained in it.

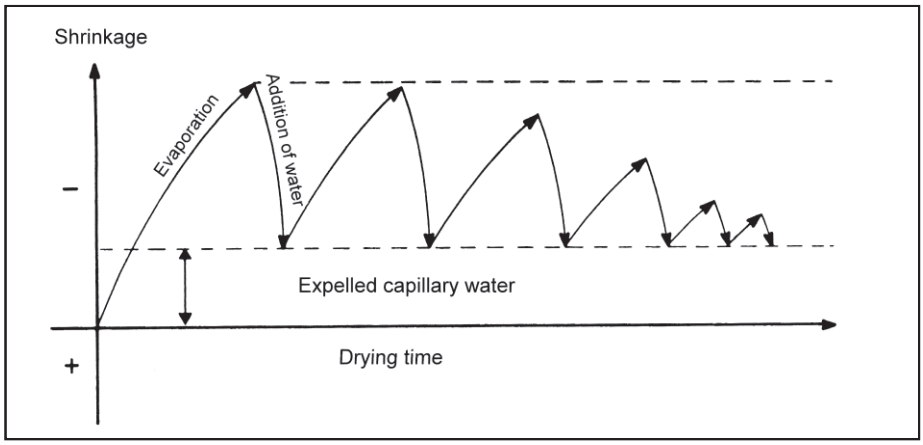


This is the reason why a certain total quantity of ISS 2500 solution is necessary for processing the area of ground in question. This is important, for if less than the total required quantity of solution is applied, its penetration into the ground will be adversely affected. These two phenomena (gas and water for-mation and surface tension) can be reduced by an increase in moisture content.

If the forces involved are reduced as a result of increased moisture content, the ISS 2500 solution can penetrate more easily into the capillary structure of the soil and the ion exchange process can take place more rapidly. The water released in consequence can therefore either seep away or be expelled by the kneading action of, for instance, a sheepsfoot roller and then evaporate at the surface. ISS 2500 therefore creates favourable conditions for compaction by changing the zeta potential of the clay and silt particles.

The zeta potential (electrokinetic potential) decreases withincreasing concentration of the ions of opposite charges from the ISS 2500 solution. The cations and anions are liberated from the diffuse double layer, which reduces the swelling properties of the soil.

The shrinkage time diagram clearly shows a kind of sawtooth pattern with the teeth diminishing to zero in course of time. It thus appears that, when water is added after shrinkage has occurred, the shrinkage decreases to an amount corresponding to the amount of capillary water that has emerged. If the soil is allowed to dry again so that water evaporates from it, the shrinkage that will then occur will never be quite as great as it was previously. This accounts for the fact that surfaces treated with ISS 2500 solution and left uncovered will always increase in stability over a prolonged period of time.



The most notable properties of ISS 2500 and their effects on the soil therefore are:

1. Reduction of the dipole moment which has a water repelling effect on the individual soil particles and at the same times reduces the swelling capacity.
2. The electrokinetic phenomenon causes the stabilisation of the soil particles. As a result, the soil acquires a higher shearing strength and its compactability is significantly improved. In general, the soil particles align themselves parallel to one another and, because of the formation of an electrical cushioning, causes a sliding effect that takes place in the horizontal molecular structure.
3. Broadly speaking, a soil of colloidal character has a structure comparable to a house of cards. Because of this, the soil can contain a fairly large amount of voids which are filled either with water or with air. During treatment with ISS 2500, these voids must in any case be filled with pore water derived from the static water. Only in this way can ion exchange by higher valency cations take place and the dipole moment of the soil particles be reduced.

When the reaction has occurred, less water can accumulate in the soil than was originally possible. As a result, the swelling capacity is reduced and the internal moisture of the soil is reduced.

Subsequent additions of water cannot reverse this process and once the latter has been accomplished, the swelling capacity is destroyed and the shearing strength is increased.

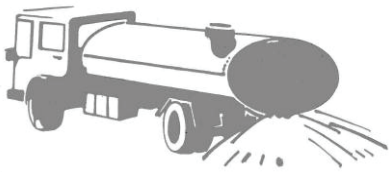
For the processing solution to function correctly, the minimum requirement is that the soil should have optimum water content. A slightly higher water content will intensify the reaction but on no account must the amount of water in the soil approach the saturation limit for this will result in the reduction in penetration power and the effectiveness of the process. A further problem that can arise if the soil water content reaches saturation is that the surface of the ground becomes sealed off by the original swelling effect.

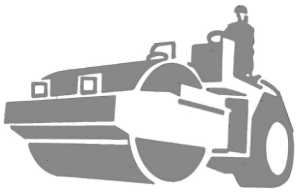
Application of *ISS 2500* ®

Equipment required

Grader (with scarifier or ripper
Water truck

Compactor (10 ton)
Disc plough, rotovator optional)





Water/*ISS* volume calculations

1 AREA TO BE STABILISED

Calculate the total area to be stabilised with ***ISS*** giving the total m^2 to be treated.

2 WATER VOLUME

ISS is applied together with the water required to bring the material to optimum moisture content. About 0,5 L for every 1cm of depth per m^2 is required but may vary according to the materials in-situ moisture content and weather conditions.
If the material is already at or above optimum, a minimum of 1 L/m^2 of water must be used.

3 *ISS* VOLUME

Standard application rate for *ISS* is 0.03 L per m^2
The area in m^2 is multiplied by the ***ISS*** application rate to give the quantity of ***ISS*** required.

Example: Area to be stabilized 7000 m^2
ISS application rate 0,03 L/m^2
7000 m^2 x 0,03 L/m^2 = **210 L *ISS***

ISS @ 0.2L/m^3	30ml per 1 m^2
	300ml per 10 m^2
	3L per 100 m^2
	30 L per 1000 m^2

4 MIXING

The total amount of water required to bring the material to optimum moisture is divided by the capacity of the water truck to estimate the total number of water loads required. The quantity of ***ISS*** required is then divided into this total number of water loads. It is advisable to only add the ***ISS*** to the **first two-thirds** of the required water loads.

Note: If optimum moisture content is obtained before the last load of ***ISS*** mixture has been applied, the excess load should be applied during or after compaction. If however optimum moisture content has not been obtained after the last load of ***ISS*** mixture has been applied, clean water without ***ISS***

CONSTRUCTION PROCEDURE FOR *ISS 2500*®
(per 150 mm layer)

Plant: Motor grader with fitted scarifiers
Water bowser of known volume
Vibratory roller (10 t minimum)
Disc harrow or rotory mixer (optional)

- Scarify area to 150 mm depth.
- Large clods or agglomerations to be broken to max 50 mm.
- ***ISS*** at 0.03 L/m^2 per 150 mm layer (0.2 L/m^3) or the required application rate must be added directly to the water bowser with the moisture needed to bring the material to optimum moisture content (OMC) for compaction.

  If the material is at OMC, a minimum amount of 1 Litre water/m^2 should be used.
- The ***ISS***-water mixture must be evenly sprayed over the entire area in multiple passes.
- The area is to be thoroughly mixed until OMC is achieved.
- Should more moisture be required after the application of the ***ISS*** to achieve OMC, clean water is to be used.
- At OMC, the area should be levelled and compacted to required density.
- Subsequent layers may then be placed or the section may be opened to traffic.
- Any exposed ***ISS***-treated areas should be lightly watered twice daily for three days or until covered.

ISS 2500® Ionic Soil Stabilizer®

Classification of highway subgrade materials

General classification	Granular materials 35% or less passing 0.075 mm							Silt / clay materials more than 35% passing 0.075 mm				
Group classification	A-1-a	A-1-b	A3	A-2-4	A-2-5	A-2-6	A-2-7	A4	A5	A6	A-7-5	A-7-6
Sieve analysis - % passing 2.000 mm 0.425 mm 0.075 mm	 #50 #30 #15	 #50 #25	 >50 #10	 #35	 #35	 #35	 #35	 #35	 #35	 #35	 #35	 #35
Characteristics of fraction passing 0.425 mm Liquid limit Plasticity index	 #6	 #6	 NP	 #40 #10	 >40 #10	 #40 >10	 >40 >10	 #40 #10	 >40 #10	 #40 >10	 >40 #LL-30	 >40 >LL-30
Group index	0	0	0	0	0	#4	#4	#8	#12	#16	#20	#20
Usual types of significant constituent materials	Stone fragments gravel and sand		Fine sand	Silty or clayey gravel and sand				Silty soils		Clayey soils		
General rating as subgrade	Excellent to good					Fair to poor						
ISS 2500® rating	**Fair to poor***		**Unsuitable***	**Excellent to good**								

* Refer to manufacturer before using ISS 2500.

LABORATORY TESTING PROCEDURES

DETERMINATION OF SOAKED CBR

Dosage of ***ISS 2500*** is determined by the percentages passing the 0.075 mm sieve.

% 0.075		
	<10%:	0.01 and 0.02 L/m^2
	10-15%:	0.02 and 0.03 L/m^2
	15+%:	0.03 L/m^2

Note: *In heavy clays with high percentages of fines, 0.04 L/m^2 may be considered.*

The following steps are taken to determine the quantity of ***ISS*** required per sample:

1. Determine the maximum dry density of the untreated soil.
2. Multiply the maximum dry density in kilograms by 0.15 (representing standard 150 mm layer).
3. Determine the required ***ISS*** application rate.
4. Determine the dry weight of the laboratory sample to be treated for the determination of the CBR.
5. The required ***ISS*** application rate in litres is divided by the weight of the material per m^2 in kilograms for the intended layer and then multiplied by the weight of the laboratory sample in grams.

   Example:

   MOD = 2000 kg/m^3; ***ISS*** = 0.03L/m^2; Laboratory sample = 5 kg

   2000 x 0.15 = 300 kg

   0.03) 300 x 5,000 = 0.5 mL

PREPARATION OF SAMPLE

2. All soil aggregations should be broken as much as possible without reducing the actual size of individual particles.
3. Determine the Optimum Moisture Content of the material.
4. Bring the sample to be treated to OMC using clean water and mix thoroughly.
5. Place the material in a plastic bag/moisture room and seal for 12-24 hours.
6. Add the required amount of ***ISS*** to 100-200 ml of water and apply to the sample.
7. Place the ***ISS*** -treated soil in a plastic tray in a loose condition and cure for 24 hours.
8. Determine the moisture content of the treated soil and correct with clean water or allow further drying to achieve OMC.
9. Place the material again in a plastic bag/moisture room and seal for 12-24 hours.
10. Compact the material in a CBR mould in 5 layers standard compaction.
11. After preparation of the mould, invert and attach to perforated base plate. Remove filter paper from top face and place perforated plate without weights on top.
12. Cure for 7 days.
13. Soak sample for 4 days.
14. Standard CBR procedures to be carried out on sample.

Note: *Enough material must be prepared to determine the new Maximum Dry Density of the treated soil*

ENVIRONMENTAL DATA

1. Manufacturer and product

Road Material Stabilizers (Pty) Ltd Unit 11, Elandsfontein Rail Complex, Hattingh Street, Isando, Gauteng

ISS 2500® Ionic Soil Stabilizer®

CAS No: Not Applicable – Mixture

2. Formulation and specifications

ISS 2500® Ionic Soil Stabilizer® is a water-soluble oily solution of ion exchange resins, sulphonated petroleum resins (modified) derived from combined sulphur and buffered acids that are combined as bisulphates. The solvent's active components of the concentrate are ±20% which include the acids.

3. Chemical analysis report

SGS South Africa (Pty) Ltd Agricultural & Food Services

(SANAS Accredited Laboratory T0114) SGS Reference No. 2712 30 November 2000

Analysis performed	Units	Method	Result
Pesticides			
Organo Chlorides	P/ND	PAM (304)	ND
Organo phosphates	P/ND	PAM (304)	ND
Carbamates	P/ND	PAM (401)	ND
Pyrethroids	P/ND	PAM (304)	ND
Organo compounds			
PAHs	µg/L	APHA 6440B	ND
VOCs	µg/L	APHA 6200C	ND

P = Present / Positive ND = None Detected

4. Acute toxicity test report

(SANAS Accredited Laboratory T0045) Analysis Report 2000/1352 (H2) 4 December 2000

Acute toxicity test (US EPA 1991)	Method number	% survival
24-hour *Daphnia Pulex*	1.1.2.04.1	100
48-hour *Daphnia Pulex*	1.1.2.04.1	95
96-hour *Poecila reticulata*	1.1.2.05.1	95

ISS 2500 5ml:5L

ISS 2500 Ionic Soil stabilizer complies with the requirements to be deemed environmentally safe and if handled according to the procedures set out by the manufacturer will not pose any hazard to health or environment.

* For further information, see MSDS

All data in this Certificate supplied by internationally accredited laboratories in accordance with the International Laboratory Accreditation Cooperation (ILAC), International Arrangement to Enhance Trade, Washington DC 2 November 2000.

TECHNICAL DATA SHEET

Road Material Stabilisers
(Pty) Ltd
1986/004184/07
PO Box 84513 Greenside
2034 Johannesburg Gauteng
Republic of South Africa
Tel 27 (0)11 390 3499
Fax 27 (0)11 390 3284
E-mail info@roadmaterial.co.za
Website www.roadmaterial.co.za

ISS 2500 IONIC SOIL STABILISER

DATE: 02/005/2004
REVISED: 19/01/2005

DESCRIPTION:
ISS 2500 is an electrochemical clay soil stabiliser suitable for improving marginal or substandard soils for use in the construction of roads.

APPLICATION RATES:
% passing 0.075 <10%: 0.01-0.02 L/m^2
10-15%: 0.02-0.03 L/m^2
15+%: 0.03 L /m^2
(refer to manufacturer before use)

BENEFITS:
- Economical construction method for use in gravel and surfaced roads
- Increase in compacted densities and bearing capacities
- Greater use of in-situ material
- No specialised equipment required
- Treatment is permanent
- Roads can be opened to traffic immediately

PREPARATION:
- Establish the suitability of the soil prior to construction
- Fill the water bowser and then add the required amount of ISS

APPLICATION:
- Scarify area to 150-200 mm depth
- Large clods or agglomerations to be broken to max 50 mm
- Add the required amount of ISS directly to the water bowser with the moisture needed to bring the material to optimum moisture content (OMC) for compaction. If the material is at OMC, a minimum amount of 1litre water/m^2 should be used
- Spray the ISS-water mixture over the entire area in multiple passes
- The area is to be thoroughly mixed until OMC is achieved
- Should more moisture be required after the application of the ISS to achieve OMC, use clean water
- At OMC, the area should be levelled and compacted to required density
- Any exposed ISS-treated areas should be lightly watered twice daily for three days or until covered

CHARACTERISTICS:

Appearance	-	oily, dark/red coloured, with characteristic odour
Specific gravity	-	1.14 @ 25°C
pH	-	<2
Diluent	-	water

HAZARDS:			**PRECAUTIONS:**	**FIRST AID:**
Fire	-	non-flammable	–	–
Explosion:	-	non-explosive	–	–
Skin	-	prolonged contact can cause minor burns	Wear protective clothing for sensitive skins	Rinse with water
Ingestion	-	harmful	Do not ingest	Do not induce vomiting*
Eyes	-	may cause irritation or corneal burns	Avoid splashing	Flush with water for min 20 min*
				(Seek prompt medical advice)

STORAGE:
Store under cover and protect containers from direct sunlight
Storage temperature - -5-60°C
Transport temperature - -5-60°C

PACKAGING / LABELLING:
Packed: - 20/100/200 litre plastic drums
Label: - company details and contact numbers

MATERIAL SAFETY DATA SHEET

1. PRODUCT IDENTIFICATION	
1.1 Product Trade Name	***ISS2500* Ionic Soil Stabilizer**
1.2 Product Type	Soil Stabiliser
1.3 Supplier	Road Material Stabilizers (Pty) Ltd Unit 29 Jansen Road Jet Park Gauteng Tel: 27 (0)11 390 3499 Fax: 27(0)11 390 3284
2. COMPOSITION	
2.2 Substance chemical	Sulphonated petroleum resins, water soluble oils, ion exchange resins
2.3 Hazardous component	Sulphuric acid < 9%.
3. HAZARDS IDENTIFICATION	
3.1 Sulphuric acid	CAS 7664 – 93 – 9 MAS % 23
4. FIRST AID MEASURES	
4.1 Eyes	Liquid contact can cause irritation or corneal burns. Mist contact may irritate or burn.
4.2 Inhalation	Inhalation of fumes or mist can cause irritation or corrosive burns to upper respiratory system, including nose, mouth and throat.
4.3 Skin	Prolonged contact can cause minor burns.
4.4 Ingestion	Can cause irritation and corrosive burns to mouth, throat and stomach.
5. FIRE FIGHTING MEASURES	
5.1 Non-flammable	
6. ACCIDENTAL RELEASE MEASURES	
6.1 Spill & Leak Procedure	ALWAYS WEAR PERSONAL PROTECTIVE EQUIPMENT. Dilute small spills and leaks with plenty of water. If in a confined area. Neutralize residue with alkali such as soda ash or lime. Adequate ventilation is required due to the possible release of carbon dioxide.
7. HANDLING AND STORAGE	
7.1 Storage	Indefinite shelf life. Protect containers from physical damage, Store under cover. Protect from direct sunlight, protect from freezing.
7.2 Handling	Do not get in eyes on skin or on clothing. Do not breath vapours or mist. Use adequate ventilation.
8. EXPOSURE CONTROLS / PERSONAL PROTECTION MEASURES	
8.1 PERSONAL PROTECTION	
8.1.1 Respiratory protection	Required if mist is present.
8.1.2 Eye / Face Protection	Goggles or full face shield.
8.1.3 Protective clothing	Rubber clothing is adequate

9. PHYSICAL AND CHEMICAL PROPERTIES

9.1 Material	Liquid. 100% organic.
9.2 Specific Gravity	H20=1.0>1.15min
9.3 Solubility in water	Completely
9.4 Appearance	Oily, dark red
9.5 Odor	Characteristic Odor
9.6 pH	<2

10. STABILITY / REACTIVITY

10.1 Stability	Stable. Not affected by temperature extremes or light.
10.2 Incompatibility (material to avoid)	Contact with reactive metals such as zinc will result in the evolution of hydrogen.
10.3 Conditions to avoid	Prolonged temperatures above 300ºC will eventually evaporate the water and sulphur trioxide could be given off.
10.4 Hazardous decomposition	Sulphur trioxide – see above.

11. TOXICOLOGICAL INFO

11.1 Environmental	NON-TOXIC
11.2 EPA Hazardous Substance	Clean water Act Section 311
11.2 Aquatic toxicity	Rand water report 1997-06-10 based on USEPA (1991) method.
11.3 Degradation	See waste disposal methods below.
11.4 Permissable Concerntration Ref	OSHA Standard (H2S04) at 29 CFR 1910.1000 (1981)
11.5 Regulatory standards	DOT Classification: Mildly corrosive material. Irritant
11.6 General	Refer to Manufacturer.

12 ECOLOGICAL INFORMATION

12.1 Experimental evidence concludes that the chemical constituents of ISS 2500 diluted with water, are not toxic.

12.2 LC_{50} of undiluted product is 0.389%

13. DISPOSAL CONSIDERATIONS

WASTE DISPOSAL METHOD

Dilute with water, irrigate as per manufacturers instructions for applications.

14. TRANSPORT INFORMATION

14.1 Packaging Size	200 kg ,100 l, 20 ldrums
14.2 D.O.T. Proper Shipping Name (49CFR172.101)	None
14.3 Hazardous substance (40CFR116)	N/A
14.4 Reportable Quantity (RQ)	N/A
14.5 D.O.T Hazard Classification (49CFR172.101)	Non –regulated
14.6 D.O.T Placards Required	None
14.7 Poison Constituent (49CFR173.343)	N/A
14.8 Bill of Lading Description	Soil Stabiliser
14.9 C NO.	N/A
14.10 UN/NA CODE	N/A

15. REGULATORY INFORMATION

15.1 Permissible Concerntration Ref	OSHA Standard (H2S04) at 29 CFR 1910.1000 (1981)
15.2 Regulatory Standards	DOT Classification: Mildly corrosive material. Irritant.
15.3 General	Refer to Manufacturer

16. OTHER INFORMATION

16.1 Abreviations and Symbols

N.D. – Not determined N/A. – Not applicable N.T. – Not Tested < - Less

T.C.
GÖLBAŞI BELEDİYE BAŞKANLIĞI
Fen İşleri Müdürlüğü

Sayı :26969142-010.99-E.21409
Konu :Yol Yapımı

17.10.2019

ERASLAN EKONOMİ YATIRIMA
Dede Efendi Sokak 88/b Çankaya ANKARA

İlgi : Eraslan Ekonomi Yatırım'ın 11.10.2019 tarihli ve sayılı yazısı.

İlgi sayılı yazıda belirtilen Eymir Mahallesi imarın 121242 ada ile 121243 ada arasından geçen yolda 2013 yılı içerisinde tarafınızca yapılan İSS 2500 ürün uygulama demosunun uygulama yapıldıktan sonraki çamurlaşma, çökme, esneme, tozuma ve zemin salınımının izlenimlerine ilişkin bilgi taleb etmektesiniz.

Söz konusu yolda tarafınızca yapılan İSS 2500 Demo uygulamasından sonra toprak yolun sertleştiği ve esnemenin olmadığı, toprak zeminin yaklaşık olarak 40-50cm derinliğe kadar yapılan işlemin etkili olduğu ancak yol güzergahı boyunca az da olsa tozlanmanın olduğu görülmüştür.

Bilgilerinize rica ederim.

e-imzalıdır
İsmail KARA
Belediye Başkanı a.
Belediye Başkan Yardımcısı

Not: 5070 sayılı elektronik imza kanunu gereği bu belge elektronik imza ile imzalanmıştır.

Gazi Osman Paşa Mahallesi Sahil Caddesi No: 3 PK:06834
0312 485 5555

Bilgi için:Mustafa ERDOĞAN
Yol Şube Şefi

SGS

SGS SOUTH AFRICA (PTY) LTD.

SGS REFERANS NO: 2712

Unit 5, Mita Park George Road Randjespark Midrand, 1685 P.O. Box 5472
Halfway House 1685
Tel: (+27-11) 652-1400
Faks: (+27-11) 652-1571

SGS GIDA VE TARIM HİZMETLERİ
C/O Cowles & East Geduld Roads Enstra
Springs P.O. Box 2357 Springs 1560

Belge Sertifika No: 2901 / 93615

ANALİZ SERTİFİKASI

ÜRÜN ADI : Ionic Soil Stabilizer® (İyonik Toprak Stabilizatörü®) (ISS 2500®)
ÜRÜN KULLANIM ALANI : Toprak Stabilizasyonu

TEST KAFİLE NUMARASI: 00/07/013 ANALİZ TARİHİ: 30.11.00

BELİRTİLEN AKTİF İÇERİKLER: YOK

KİMYASAL VERİLER:

UYGULANAN ANALİZ	BİRİM	YÖNTEM	SONUÇ
PESTİSİTLER:			
ORGANOKLOR	P/ND	PAM I (304)	ND
ORGANO FOSFAT	P/ND	PAM I (304)	ND
KARBAMAT	P/ND	PAM I (401)	ND
PİRETROİD	P/ND	PAM I (304)	ND
ORGANİK BİLEŞİKLER:			
PAH	µg/L	APHA 6440B	ND
VOC	µg/L	APHA 6200C	ND

FİZİKSEL VERİLER:

Görünüm ve koku : Petrol hidrokarbon ve asetik kokulu koyu renkli sıvı.
Özgül ağırlık : SG @ 20 °C = 1.14
pH : pH @ 25 °C < 2
Suda çözünürlük : Tamamen çözünür
Elektriksel iletkenlik : EC @ 25°C = 60500 . 00mS/m
Yanabilirlik : Yanmaz
Kalıntı / Tortu : Elde edilen kimyasal veriler sonucunda ISS 2500® ün herhangi bir organik bileşen ya da pestisit kalıntı bırakmadığı görülmüştür.