

Questions answered:

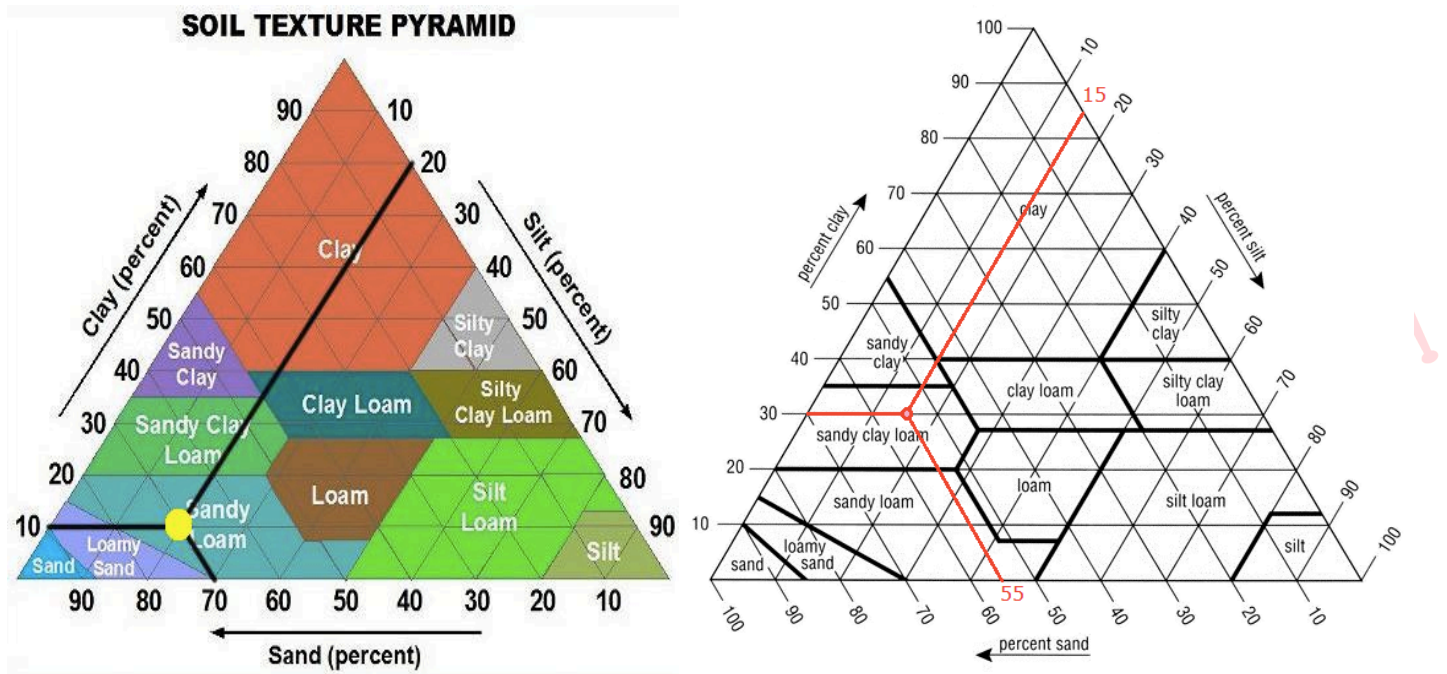
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What is the ideal mixture for a baseball infield?

IDEAL	ACCEPTABLE	ACCEPTABLE
70% Sand (MEDIUM)	70% Sand (MEDIUM)	75% Sand (MEDIUM)
20% Clay	15% Clay	15% Clay
10% Silt	15% Silt	10% Silt

What is this type of soil called?

- The name for it is defined by its texture classification -- Sandy Loam or Sandy Clay Loam



What do the individual parts of the mixture do?

All earthen soils have variable percentages of sand, silt and clay

- Sand - structure, drainage
 - Provides the bulk of the mix; Creates a firm platform when properly compacted; Yields a softer playing surface but requires limited maintenance and drains well
- Silt - binding/cohesion, structure
 - Fills gaps between sand, clay particles creating good gradient; Resists water penetration, promotes surface drainage
- Clay - water retention, binding/cohesion
 - Holds water in the soil mixture, adding strength, weight, density; Bonds with other clay particles around/through sand and silt particles - weaves the fabric together into a solid mass; Allows sharp/athletic movement, promotes traction on the surface

What is the most important focus of an infield mix?

The central concern for any soil mixture being considered is the silt-to-clay ratio (SCR)

- To find this you divide: $\frac{\% \text{ Silt}}{\% \text{ Clay}}$
- The ideal range for an infield mix would be a ratio between .5:1 and 1:1
- This would mean silt percentages $\frac{1}{2}$ of or equal value to clay percentages

Based on the ideal mixtures we have provided (above), SCR value would be

IDEAL	ACCEPTABLE	ACCEPTABLE
70% Sand (MEDIUM)	70% Sand (MEDIUM)	75% Sand (MEDIUM)
20% Clay	15% Clay	15% Clay
10% Silt	15% Silt	10% Silt
SCR - .5:1	SCR - 1:1	SCR - .67:1

How do I find out the silt-to-clay ratio/where do I get the percentages for silt and clay?

For any earthen substance available for sale - topsoil, loam, aggregate, crushed stone/brick - technical reports should be available from the retailer on request which will show these breakdowns

- The test you are interested in -- Particle Size Distribution (PSD) and/or Sedimentation Test

Why is the silt-to-clay ratio so important?

Below (as above) we describe what the function of each particle/component is for the soil mass. The measurement of SCR is about ensuring that the percentages are balanced so that the functions are balanced -- you don't get too much/or too little performance in each area

- Sand - structure, drainage
- Silt - binding/cohesion, structure
- Clay - water retention, binding/cohesion

Silt-Rich, higher ratios $>1:1$ -- NEGATIVES: excess water retention; soft surface, subject to pooling; hard, dusty and eroded easily by wind in dry weather (creating lips in infield/cutout grass); will become super-saturated, slippery, unstable, sludge in rain.

Clay-rich/Silt-Poor, lower ratios $<0.5:1$ -- NEGATIVES*: lacking water retention; rock hard surface, uneven and rough; will become excessively heavy and sticky in wet weather.

*If you have ever used a cricket loam independent of other additives, rich in clay and silt, you would have observed rock hard conditions in dry periods and distinctively heavy, sticky conditions (taking boots full of infield off the field) in wet conditions.

Is there anything specific about the sand component?

Size and shape matters -- particles classed as sand are simply particles of a particular size range:

Sand	Grain Size -- Diameter in mm	% of Sand Component for Infield Mix
Very fine grain	0.063 - 0.125mm	N/A
Fine grain	0.125 - 0.25mm	≤ 20%
Medium grain	0.25 - 0.5mm	≥ 60%
Coarse grain	0.5 - 1.0mm	≤ 20%
Very Coarse	1.0mm +	≤ 3%

For reference, clay and silt are likewise classified according to particle size range:

Particle	Grain Size -- Diameter in mm	% of Infield Mix
Silt	0.002 - 0.063mm	≤ 15%
Clay	0.0 - 0.002mm	≤ 20%

As with other earth materials products for sale, technical reports are available on request. Particle Size Distribution (PSD) test should reveal this but it can be best practice to ask about the shape profile directly.

- 60-80% of the sand in your mix should be medium sized: 0.25 - 0.5mm
- The shape of the particles should be: sub-angular, sub-rounded to rounded*

*Redgras - angular sand; sharp

Sand is such a big component part -- why is it so important?

Higher sand content infield mixes, properly compacted, yield softer surfaces but optimal drainage and require significantly less maintenance. Clubs and facilities with limited man-hours and limited budgets for grounds keeping and maintenance need to focus on fields that can handle the most weather with the least care

- Priority is drainage - Playing on a field that is too wet is impossible; possible to play if too dry
- Infield mixes with high clay content (30-50%) require a significant amount of active watering
- Sand is the cheapest component

Can I have too much sand?

A good infield mix is balanced correctly according to its desired function. Having disproportionate amounts of any of the three components creates problems related to too much/too little functionality.

Sand-Rich -- NEGATIVES*: becomes softer in wet conditions; when too dry becomes very loose and unstable, displacing more earth when trying to make sharp moves; sharper particles can cut/shear

* Anyone who has played on Redgras in drier conditions, at the height of summer knows these effects. This material is 100% sand -- as such you may find yourself rebuilding/re-leveling large holes in the mound every inning, or cutting your clothes/person sliding into bases.

Can I use anything in place of/in addition to sand in my infield mix?

All of the below suggestions can generally be referred to as soil conditioners.

Particle sizes should all be <5mm, classing all of the below as sand. They can wholly or partially replace any necessary additions of sand that must be made to an infield and can also be used as a direct response to wet conditions to prepare or repair a field after rain.

These options provide an additional functionality (described) to any infield mix, but as with all other component parts, are unsuitable independently.

- Crushed Limestone
- Crushed Brick/Brick Dust
- Crushed Terracotta*
 - Crushed Ceramics/Secondary Use
 - Porous, leeches water and helps soil to stay drier, longer in rain
 - Releases absorbed water slowly keeping soil moist in arid conditions
 - Reduces compaction, increase oxygenation
- Calcined Clay*
- Soil Conditioners
 - Custom Fabricated Ceramics
 - Porous, leeches water and helps soil to stay drier, longer in rain
 - Releases absorbed water slowly keeping soil moist in arid conditions
 - Reduces compaction, increase oxygenation

* Sources for these products have yet to be found at affordable rates or which have been designed for agricultural or soil conditioning purpose (screened to the appropriate particle sizes)

How do I calculate how much I need?

You will need to have the following information:

- Area of the intended space - square feet or square meters
- Depth of the intended space - inches or millimetres
 - Standard depth for laying infield mix should be 4-6 inches/101-152mm
- Calculated value in meters cubed - width x length x depth
 - 1 tonne = 1-1.3 cubic yards
 - 1 tonne = 1 cubic meter

$$\frac{\text{Area of infield skin (square feet)} * \text{Depth of material (inches)}}{27 \text{ cubic feet per cubic yard}} = \text{cubic yards needed}$$

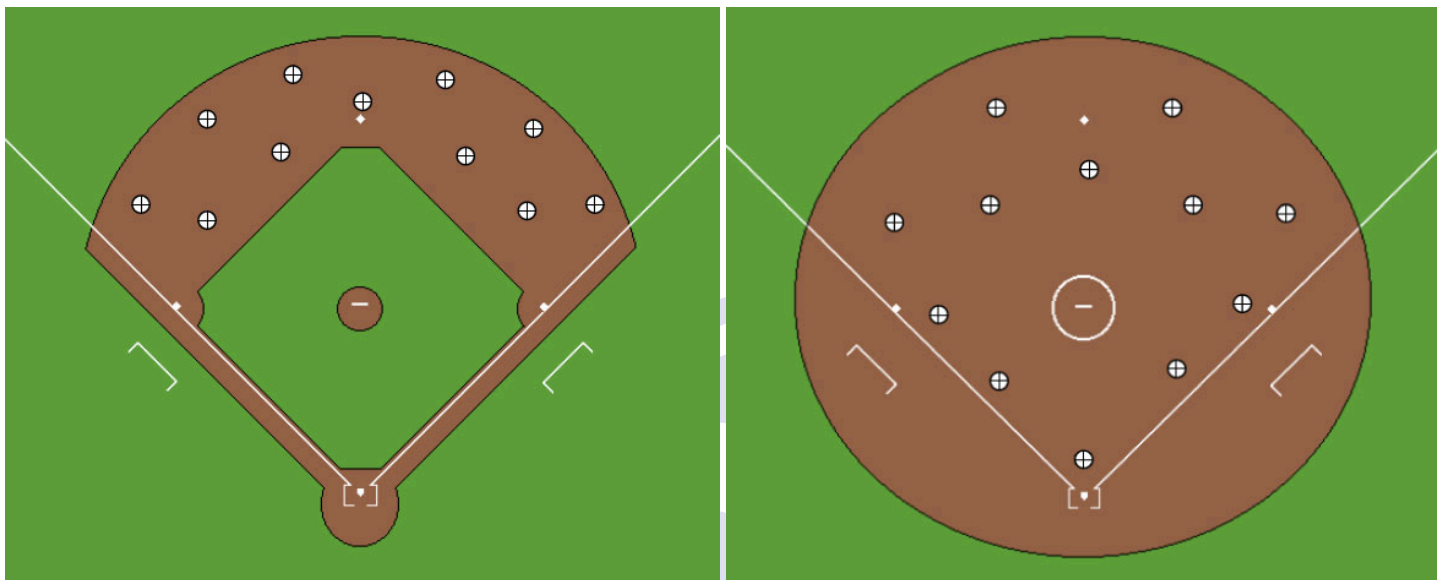
$$\frac{\text{Area of infield skin (square meters)} * \text{Depth of material (cm)}}{100,000 \text{ cubic centimeters per meter}} = \text{cubic meters needed}$$

How do I know what I need to improve my existing infield mix?

The most important step for improving an infield mix is to determine what is currently in place. Paying for a laboratory soil analysis is easy and affordable.

- Cost ranges between £50-£80 per sample tested
- Minimum required sample size for testing is going to be between 1-3kg.

When collecting your sample it is important to collect from a variety of positions around your infield to ensure provision of a sample that is representative of the entire mixture.



The tests we want conducted:

- Particle Size Distribution (PSD) with Sedimentation
- Plasticity Index (PI)

A list of laboratories that conduct this type of work have been provided below:

Bourne Amenity	http://www.bourneamenity.co.uk/soil-advisory-service.html
Amenity Land Solutions	http://www.amenity.co.uk/als-soil-analysis/index.html
Pitchcare	http://www.pitchcare.com/shop/pitchcare-soil-analysis-and-soil-testing-kits/index.html
STRI	www.stri.co.uk
Tim O'Hare Associates	www.toha.co.uk
Enverity	www.enverity.co.uk
NRM Ltd	www.nrm.uk.com
Southern Testing	www.southerntesting.co.uk
Mayer Environmental	www.mayer-enviro.com
K4 Soils	http://www.k4soils.com/Pages/default.aspx
GeoLabs	http://www.geolabs.co.uk/

What do I do to improve existing deficiencies in my infield mix?

Soil analysis and an understanding of what deficiencies must be corrected is the first step.

- Infield is too clay-rich but obeys SCR ratios
 - Additions of correct volumes of sand or brick dust can work your existing mix toward desired ratios
 - This process is difficult to do en masse without heavy machinery so is better planned as an ongoing process of care
- Infield is too silt-rich or sandy
 - This is more difficult as there is no way to add clay alone to balance against high silt - whatever clay source you find will have a silt percentage as well
 - This will mean adding high volumes of soil that obeys SCR ratios and steadily decreasing the silt percentage
 - Again this plan is difficult without heavy machinery and is best considered a plan ongoing over time

Where is BSUK looking for products?

- There are industries and vendors of products that fit the profile
 - Cricket Loam Companies - Blended Soils, Sands
 - Sports Turf Companies - Blended Topsoil, Sands, Soil Conditioners
 - Landscaping Companies - Blended Topsoil, Sands, Soil Conditioners
 - Agricultural Companies - Blended Topsoil, Sands, Soil Conditioners
 - Aggregate - Crushed Aggregate/Brick, Sands
 - Construction Companies - Crushed Aggregate/Brick, Sands
 - Brick Manufacturers - Clay, Crushed Brick

What can I be looking to buy with confidence?

- Blended topsoil that obeys our parameters
 - Bourne Amenity TS6
http://www.bourneamenity.co.uk/assets/files/Technical%20Analysis/Top%20Soils/TS6_Topsoil_Sept_2014.pdf
- Soil Conditioners, Crushed Brick
 - As a means to respond actively to rain
 - As a means of improving resistance to rain, top-dressing the infield
 - Profile Greens Grade - Available at Rigby Taylor
http://www.rigbytaylor.com/Shop+by+Product/Soil+Improver+Conditioner/Soil+Amendment/Profile+Greens+Grade+Soil+Amendment+2268Kg_0212302-.htm
- Cricket Loam
 - As a source of clay for mounds and plate areas
 - Best if mixed with crushed brick and/or medium sand (1 part clay, 2 parts brick dust/sand)
 - Boughton Kaloam - £8.59 for x1 25kg bag
 - Boughton County Loam - £9.53 for x1 25kg bag
 - Binder Ongar Loam - £4.06 for x1 25kg bag
 - Binder K Pitch Dressing - £3.90 for x1 25kg bag

What options does BSUK recommend?

These are the three approaches being explored by BSUK.

- Topsoil Blend - describe the 70/20/10 requirement and ask whether the companies have a product like this or the means and material to produce such a product.
- Cricket Loam Blend - cricket loam companies can provide volumes of loams that are closer to the necessary mixture. Blending these products with sand or brick dust to achieve a mix closer to 70/20/10 percentages.
- Raw Clay Blend - brick and mining industry clays that obey the necessary silt-to-clay ratio need only to be blended with correct amounts of sand or brick dust to achieve desired infield mix.

How does the blending of materials help us achieve the desired mix?

Achieving the correct percentages for a bespoke soil mixture is down to two things:

1. Knowing the composition breakdown for your foundation materials
2. A calculation based on volume/weight*
 - a. If starting from zero -- Knowing how much material you need
 - b. If you are adding to existing infield mix -- Knowing how much material you have

* Volume, weights are not interchangeable and vary based on density. Calculations are estimates.

Example 1

Cricket Loam Blend -- with sand/brick dust at 1:1 or 50% of each by volume.

Binder K-Pitch Dressing - 16% sand, 41% clay, 43% silt - unsuitable independently / Negative SCR

- 1 tonne (1000kg) of Binder K-Pitch equals x kilograms of individual components

1000kg Binder K-Pitch * .16 = 160kg sand

1000kg Binder K-Pitch * .41 = 410kg clay

1000kg Binder K-Pitch * .43 = 430kg silt

- 1 tonne (1000kg) medium sand or brick dust equals 1000 kilograms of sand

160kg sand + 1000kg sand = 1160kg sand

+ 410kg clay

+ 430kg silt

2000kg / 2 tonne total

- Calculation of new percentages

1160kg sand

2000kg material = 58% sand

410kg clay

2000kg material = 20.5% clay

430kg silt

2000kg material = 21.5% silt

- We change ratios/decreased SCR by increasing volume and approach target percentages

Example 2

Raw Clay Blend -- with sand/brick dust at 1:1 or 50% of each by volume.

Oxford Clay - 22% Sand, 45% clay, 33% silt - unsuitable independently / Positive SCR

- 1 tonne of Oxford Clay equals x kilograms of individual components

1000kg Oxford Clay * .22 = 220kg sand

1000kg Oxford Clay * .45 = 450kg clay

1000kg Oxford Clay * .33 = 330kg silt

- 1 tonne medium sand or brick dust equals 1000 kilograms of sand

160kg sand + 1000kg sand = 1220kg sand
+ 450kg clay
+ 330kg silt
2000kg / 2 tonne total

- Calculation of new percentages

1220kg sand

2000kg material = 61% sand

450kg clay

2000kg material = 22.5% clay

330kg silt

2000kg material = 16.5% silt

- We change ratios/decreased SCR by increasing volume

In both cases, 1 part to 1 part combination has not pushed us to our target levels - 70/20/10. This means that different combinations will have to be tested - 1 part to 2 parts, 1 part to 1.5 parts, etc.

How do I tell someone what percentages I need?

When asking an industrial supplier if they can render a custom mix for you, the most important thing to be able to explain is the composition of the mix.

- You want sand whose particle size is 60-80% medium to coarse by volume.
- You want a source of clay soil whose SCR is .5:1 ideally, or 1:1 at minimum.
- You want a finished product that is 70% sand, 20% clay, 10% silt.

You are not asking someone to add 7 parts sand to 2 parts clay to 1 part silt - these components, particularly the latter two, are not available or suitable independently.

All soils are made up of clay, silt and sand, each type of soil having varying percentages of each. Clay, as a soil type, represents a variety of soil defined by having a significant percentage of clay particles in addition to percentages of sand and silt.

It is best to understand that the search is for two specific pieces - sand as one and clay/silt as the other.

Agripower constructed Farnham Park -- what materials did they use and are they available?

Agripower did sell a suite of custom products for baseball that they researched and developed for use at Farnham Park.

The method they followed for generating this mix was the raw clay blend described above - a combination of percentage parts clay and brick dust. They worked directly with a brick manufacturer on development. The upturn in the housing market in the UK has increased demand nationally from brick manufactures for supplies of brick clay and brick dust and Agripower's source was no longer able to provide the materials or the mixing service.

How do I respond to heavy rain?

Rainfall can be a benefit to your dirt areas, particularly if your field is not set up for access to a water supply. Soil requires some moisture to maintain ideal performance.

That said, because the amount of rainfall and water volume cannot be controlled, protecting the dirt areas with tarps is the first and best response. It is important to monitor weather radars to know when a storm may arrive and how long it will remain - applications for smart phones are free and simple to use.

Products like brick dust and other soil conditioners can be used to recover wet areas after a storm has subsided. However, because these products can be expensive and/or club supplies limited, throwing loads of material on a field if the rain is due to remain in the area can be just as good as throwing money away. Before using materials with associated costs to recover a field, check your weather radars and be sure your tarps are in place.

WARNING -- Do not use cat litter material to recover wet areas on your field. This substance is clay based and will absorb water, but is made from an expansive clay group (montmorillonite) and when saturated, becomes very tacky, heavy. Unlike listed soil conditioners, this product has no long-term value to your ball field and can be hazardous in the short-term.

What do I need to do differently in the mound and batters box areas?

Because these areas have a higher usage and are subject to more wear, these areas should be built up with higher clay content materials.

- Cricket loams - potential application, unconfirmed
- Unfired clay bricks - for use as a building material

Unfired clay bricks can be sourced from brick manufacturers and can be laid out at a minimum depth beneath your pitcher's mound and batter's box areas to form a solid foundation.

The precise product requirements for baseball should be explained as follows:

- Unfired aka "Green" Brick
- Non-perforated
- Solid
- Without "frogs"

What year-on-year changes should I expect?

No matter what materials you may use, there will be change from year to year. In order to monitor these changes, prepare for them and respond appropriately, soil should be tested at the beginning of each season to determine what has changed based on the previous year's tests.

Basic erosion, caused by wind, rain, usage/play will cause loss of volume. Compaction of dirt areas on your diamond will be a product of use and while some of this is recoverable by nail-dragging and working the surface into condition in spring, it is best to plan to add to the soil levels to bring them back up each year.

What do I need to do to maintain my infield?

Best practices include the following:

- Sweeping the lips -- broom the grass edges around your dirt areas, pushing loose soil that has been tracked into the grass back into the soil. This limits loss, protects your lips from becoming overgrown and dangerous or dying off, choked by the infield mix.
- Nail dragging -- this should happen a few times a season, cutting into the soil and then raking it back smooth will essentially till the soil and redistribute the mixture.
- Top dressing -- if you have done a soil test and know with confidence what is on your field, you can top-dress with soil conditioners like brick dust or even sand and improve the handling of wet weather without making too large an impact on the percentages/balance of your mix. You can also add to your levels and keep the playing surface even.

Questions to be asked of potential suppliers?

- Can you execute custom soil mixes?
- Do you screen base materials yourself or is it done at the quarry site?
- What size screens (mm) do you/they use to sift?
- Does the material contain stones and vegetative matter?
- Can I see your operation?
- Can I take a random sample at your site?
- Can you send me a sample?
- Can you provide me with a current textural analysis of your materials?
- What is your sand/soil particle size distribution (PSD) and percentages of each size?
- Can you show me the ratio data and particle size data for a finished product before I buy?
- If I am not satisfied with the mix can I send it back?
- Can you send me the same mix every time I order it?
- Do you have a client list that I can contact?

If you believe that your facility or club require something beyond the information or examples we have provided, whether because you would prefer something more tailored to your ground, or potentially, because you have better information than we do, we welcome your direct contact to forward these investigations and improve the sports resources.

Thanks for your assistance!