AXIS®

CALCINED DIATOMACEOUS EARTH
SOIL AMENDMENT

Amends soil with naturally porous diatoms

Increases plant available water
Resists compaction
Balances O_2 and H_2O in soil
Increases infiltration
Buffers soil temperatures

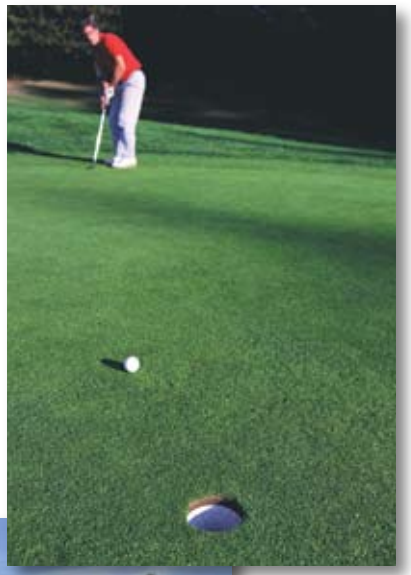
Adding non-compacting pore space with AXIS® is the key to better turf performance and easier turf management

You can keep treating symptoms. Or improve your soil structure once and for all with AXIS®.

How much time and money is spent dealing with turf maintenance problems that could be avoided if only your root zone was in better condition?

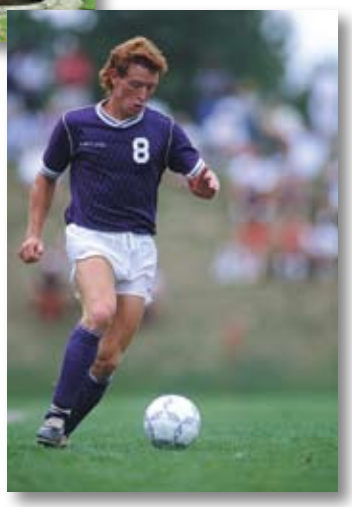
AXIS® promotes deeper, denser rooting

It's basic soil physics and agronomics. Better soil structure — specifically, the increase of permanent, non-compacting pore space — leads directly to better turf results and easier maintenance.



Golf Courses

Landscapes



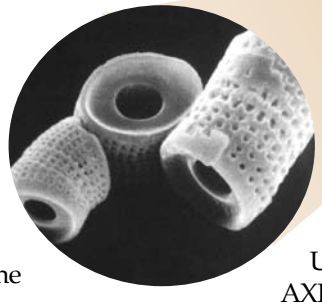
Sports Fields

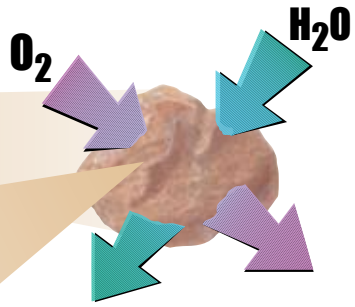
AXIS® is a scientifically proven way to add permanent porosity to your soil, which leads to positive turf response, and reduced maintenance requirements.

AXIS® calcined diatomaceous earth (DE) soil amendment changes the physical structure and texture of soil like no other amendment does because of the combined effects of its low bulk density, unique internal continuous porosity, and durability. The results you can expect are based on solid science and the experience of turf professionals around the world. AXIS® meets or exceeds all USGA Green Section recommendations for stability, infiltration, porosity, and particle size distribution.

Adding AXIS® is one permanent soil improvement you can make that will pay back dividends with better turf and plants, and easier maintenance for decades to come.

AXIS® DE: a unique naturally occurring mineral





AXIS® Fine holds 142% of its weight in water, with continuous internal pores naturally designed for air and water movement.

The amazing diatom

Nature designed this tiny organism for efficient movement of water and air. Like a microscopic hard sponge, the diatom holds the key for adding permanent porosity to soil.

Calcined for extreme durability

AXIS® is kiln-fired at extremely high temperatures, around 1800° F, to create a hard, durable, yet highly porous particle. AXIS® is stable under temperature extremes and all kinds of moisture conditions. University research shows AXIS® behaves like sand when subjected to repeated freeze / thaw cycles. Chemically inert, AXIS® will not interfere with soil chemistry.

AXIS® helps balance air and water in soil

University research shows the natural porosity of AXIS® gives you more latitude in turf management during both droughty and extremely wet conditions. AXIS® helps modify both extremes in the soil because of its unique honeycomb structure.

Helps flush salts from soil

Adding continuous soil porosity with an inert product such as AXIS® improves overall water movement in soil, which in many cases can help remove undesirable salts.

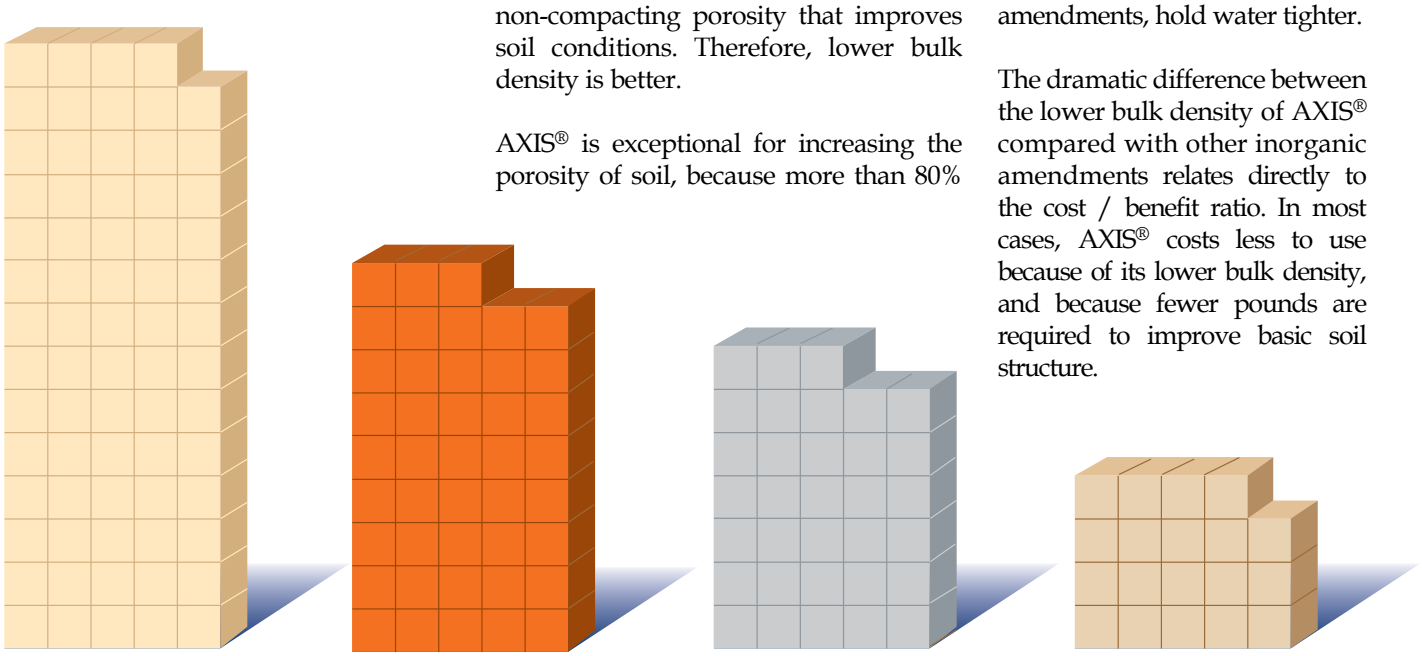
Pound for pound, AXIS® provides more non-compacting pore space

Lower bulk density is better when it comes to inorganic soil amendments

The net beneficial effects of inorganic soil amendments are based on volume, not on weight. It is the increase of continuous non-compacting porosity that improves soil conditions. Therefore, lower bulk density is better.

AXIS® is exceptional for increasing the porosity of soil, because more than 80% of the internal pores are from 0.1 to 1.0 microns in size. Smaller internal pores, such as in clay amendments, hold water tighter.

The dramatic difference between the lower bulk density of AXIS® compared with other inorganic amendments relates directly to the cost / benefit ratio. In most cases, AXIS® costs less to use because of its lower bulk density, and because fewer pounds are required to improve basic soil structure.



AXIS®
Approximately 69 cubic inches per pound

CLAY AMENDMENTS
Approximately 43 cubic inches per pound

ZEOLITE
Approximately 33 cubic inches per pound

USGA SPEC SAND
Approximately 19 cubic inches per pound

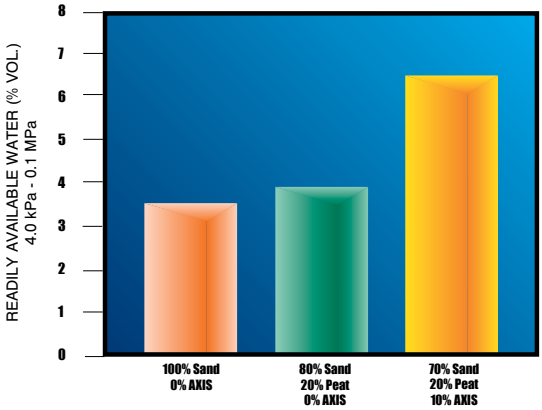
Unprecedented scientific research and testing

AXIS® has undergone numerous research studies at leading universities; many research programs are ongoing. However what may be the most statistically credible research ever done on a single inorganic soil amendment was an AXIS® project conducted by Dr. Ed McCoy at Ohio State University over a three year period.*

Following are highlights of Dr. McCoy's findings. The results are broken into two areas of effect:

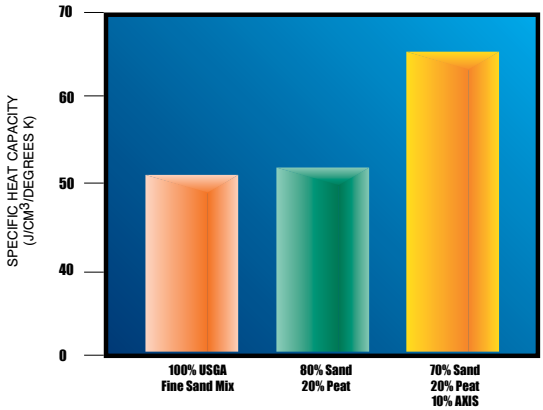
(1) How AXIS® improves soil structure, and
(2) How turf and plants respond to this improvement.

What AXIS does for soil



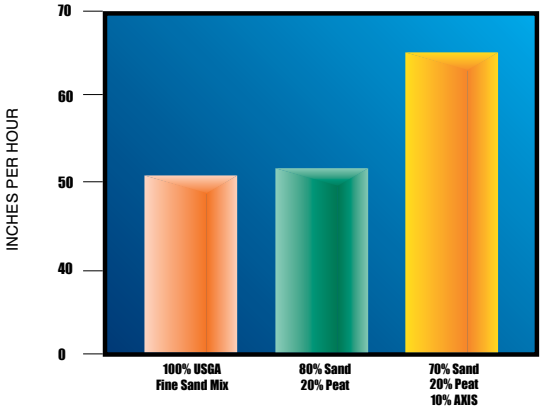
AXIS® increases available water

Increased available water means that AXIS® holds moisture in reserve for use by plants during droughty conditions. It was previously believed that inorganic amendments held water too "tightly" to be used by plants. This research proves that AXIS® releases water making it available to plants.



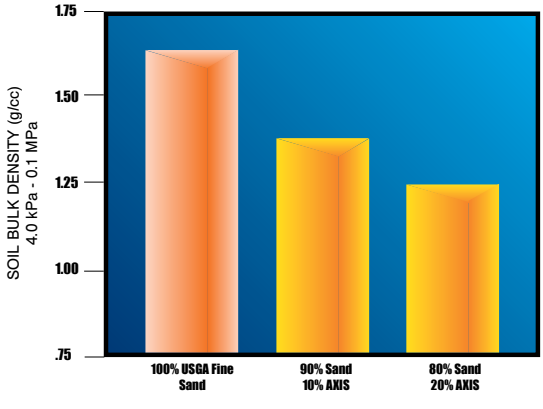
AXIS® increases soil heat capacity

Higher heat capacity means that a soil will warm or cool more slowly, giving turf managers more latitude when responding to dramatic temperature changes.



AXIS® increases soil permeability

Increases in both available water and permeability are desirable, but were generally thought to be mutually exclusive properties until science proved AXIS® does both.

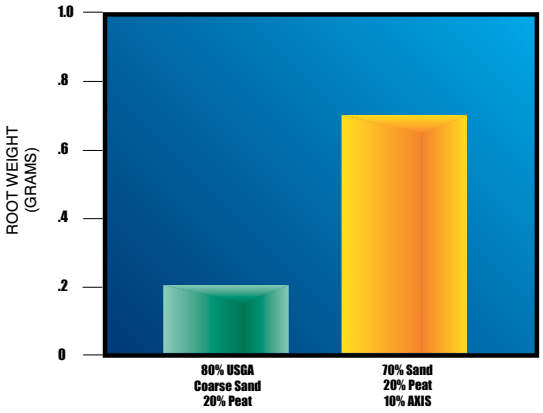


AXIS® reduces soil bulk density

Added to USGA sand and sand/peat greens mixes, AXIS® dramatically reduces soil bulk density because of its internal porosity. Other inorganic amendments, such as clays and zeolites, do not reduce soil bulk density as effectively on a volume to volume basis.

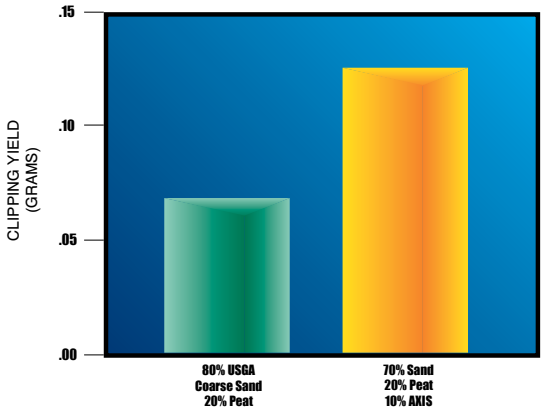
** A more detailed synopsis of Dr. McCoy's three-year research project is available on request.*

What AXIS® does for turf and plants



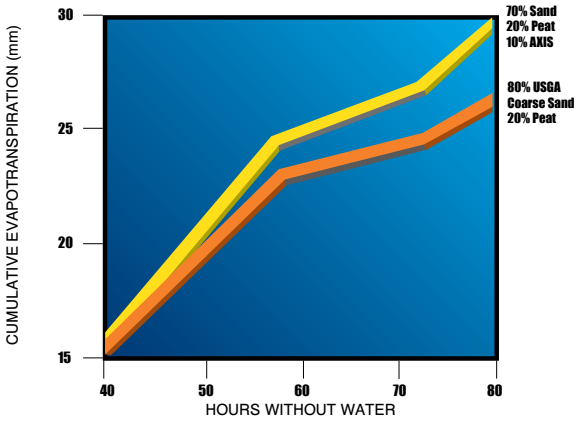
More and deeper roots

AXIS® promotes deeper roots, and greater numbers of fine root hairs. This graph indicates increase of total root mass at the 6" to 8" depth. A stronger root system helps turf and plants resist disease, drought, and other stress factors.



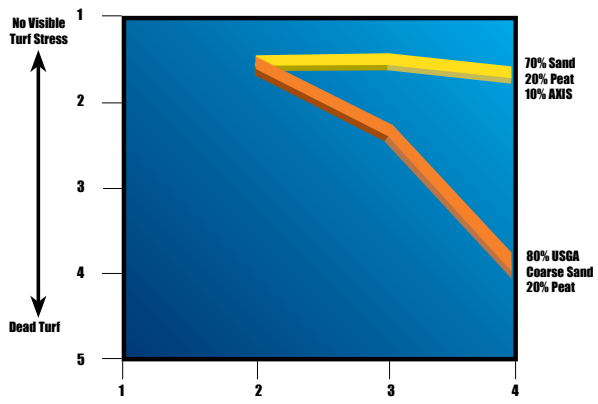
Improved clipping yields during stress

The ability of AXIS® to aid in droughty conditions is indicated by improved clipping yields when turf is under water stress.



Increased transpiration

Differences in cumulative evapotranspiration are a good indicator of the overall health of turf. In this study, turf in AXIS® plots outperforms turf in USGA coarse sand / peat mix under water stress conditions.



Better looking turf during stress

Early in the Ohio State research, it was noted that turf planted in an AXIS® mix was visibly greener during times of water stress. This highly beneficial effect was measured and recorded.

Experts agree: AXIS® is highly effective

States Dr. Raj Mehta, noted microbiologist, "AXIS® produces an oxygenating effect in soil because of its unique internal porosity. Beneficial bacteria thrive under such conditions, given adequate moisture, temperature, and food source. Healthy populations of beneficial bacteria, such as *Azotobacter sp., Pseudomonas sp., Bacillus sp.,* and beneficial fungi produce enzymes that are antagonistic toward damaging soil organisms such as *Pythium, Rhizoctonia,* and *Fusarium."*

Concludes Dr. Ed McCoy, "By addition of 10% AXIS® to sand/peat blends, we observed the following improvement in root zone parameters:

- Reduced bulk density
- Increased available water, particularly for coarse sand
- Increased permeability, particularly for fine sand
- Increased buffering of soil temperature

This improvement of the root zone mix resulted in healthier turf as confirmed by the following observations:

- More and deeper roots
- Increased clipping yields, particularly for coarse sand
- Increased evapotranspiration
- Increased canopy temperature differential
- Better visual appearance following stress

AXIS® improves soil structure in a wide variety of applications

Wherever plants grow, they grow better when soil conditions are improved. AXIS® amends virtually any soil to permanently improve its structure and texture. Added to heavy clay, AXIS® makes soil more friable. Added to sand-based soil, AXIS® helps it retain more moisture. For loamy soils, AXIS® helps balance the air and water content in the soil for easier maintenance and reduced input requirements.

Golf courses

If a golf course green hosts 40,000 rounds per year, this foot traffic translates to approximately 2,000,000 foot-falls on every green. Added to equipment weight during mowing and other maintenance, it's easy to imagine the tremendous physical forces causing soil compaction.

AXIS® resists compaction because of its extremely low bulk density and durability. When used to modify greens soil profiles, during new construction or soil modification programs, AXIS® helps any soil resist the damaging effects of compaction.

AXIS® amends USGA specification sand greens, both fine sand and coarse sand, to enhance greens performance. For fine sand USGA greens, AXIS® increases pore size distribution to enhance drainage characteristics. For coarse sand USGA greens, AXIS® helps retain moisture in the root zone by holding water at plant-available tension levels.

Use AXIS all around the course

Many courses also use AXIS® to treat walk-off areas, tees, and other turf areas subject to heavy foot and cart traffic. Additionally, AXIS® is widely used in flower beds, for backfill around new tree plantings, and for container plants, such as located on patios and entry areas.

Sports Fields

With heavy play and practice schedules, sports fields easily become compacted, resulting in worn or bare turf areas. By adding porosity to the soil with AXIS®, even the hardest native soils can be amended to allow turf to recover more quickly, and respond faster to regular maintenance. Additionally, improved soil allows fertilizers and pesticides to be more effective, sometimes at lower rates, to produce a better playing surface.

World Cup-quality soccer fields

The J-Village World Cup Soccer Training facility in Japan is composed of 11 soccer fields. Each was constructed with AXIS®. Prior to construction, AXIS® was compared with other DE and clay-based amendments. After 18 months of extensive on-site field testing, AXIS® was chosen as the most efficient and cost effective amendment. The result is one of the world's largest single applications of inorganic soil amendments.

NFL-quality football fields

The innovative new NFL field in Baltimore, designed by Vince Patterozzi, features AXIS® as an integral part of the system. "The natural porosity and durability of AXIS® makes it as near the ideal soil amendment as I've seen. And I've seen them all," says Patterozzi.

Landscape

Landscape architects are highly skilled at creating beautiful outdoor spaces, designed to refresh the spirit and serve a wide variety of social functions. Sometimes the condition of the soil at landscape installations is the last budget item to be considered, yet it can be the best way to ensure success.

Soil amended with AXIS® helps ensure that the original designs perform as the architect intends. Trees, shrubs, annuals, perennials, rooftop gardens and container plants respond better with AXIS in the soil mix, including those specified for challenging urban environments.

A University of Florida study showed that AXIS® added to the soil mix with container-grown Hibiscus, for example, enhanced plant growth up to 40% due to stronger, healthier roots.

Soil experts at the Getty Fine Arts Museum in Los Angeles, USX Headquarters Building in Pittsburgh, and other prestigious installations specified AXIS® to help ensure the integrity and performance of the architect's designs. Says one landscape architect, "AXIS® is like a permanent insurance policy for plants. It provides better performance, and peace of mind."

Application Guidelines

New Construction and Renovation

AXIS® is very effective when used to renovate greens, tees, and heavily compacted turf areas such as cart paths, walk-off areas, and for sports field renovation projects.

AXIS® is most effective when added 10% by volume in the top 6" of the soil profile.

For applications where soil is mixed prior to application, such as golf course greens mixes, AXIS® incorporates very quickly and uniformly with all types of sand and sand/peat blends.

For applications where soil is amended in place, AXIS® is applied by spreading on the surface, then tilled into the soil profile.

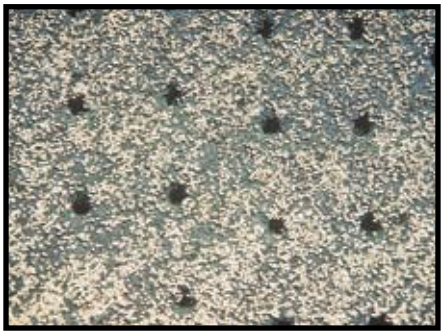
For renovation, following removal of old turf, and prior to final grading, AXIS® is applied 10% by volume to the top 6" of the soil profile, then tilled in.

Typical Application Guidelines:

Add 900 to 1300 lbs. (equalling 10% by volume) of AXIS® per 1000 square feet. Rototill 4" to 6" deep to incorporate.

OR

Premix 10% AXIS® by volume with sand/soil mix, then apply this mix to the top 4" to 6" of soil profile. For calculation purposes, 10% AXIS® by volume equals 70 pounds of AXIS® per cubic yard of mix.



Topdressing

A 50% AXIS®, 50% sand blend is a highly effective topdressing when applied in conjunction with core aeration for soil modification.

For topdressing as treatment for thatch buildup, AXIS® adds oxygen to the thatch layer to encourage decomposition, and adds permanent pore space to soil as it works down through the thatch layer over time.

Ask your AXIS® dealer for more information about AXIS® used as a topdressing carrier for microbial inoculants to increase beneficial microbial activity in soil.

Typical Application Guidelines:

A 50% AXIS® / 50% sand mixture is used for topdressing problem areas. A 90% sand / 10% AXIS® mixture is used to topdress previously amended soil as a preventative measure.

A light topdressing with 100% AXIS® helps reduce algae build-up, as reported by many superintendents.

Landscape and Horticulture

AXIS® helps promote healthier turf and plants with less water use, reduce fertilizer requirements, reduce soil compaction, improve drainage, and reduce the loss of new sod.

There are as many ways to apply AXIS® for landscape purposes as there are ways to grow plants, from rooftop gardens to urban trees. Following are the most common applications of AXIS® to enhance turf and plant performance in various landscape requirements.

Typical Application Guidelines:

For new lawn seeding or sod preparation:
Rototill or pre-mix 1 to 3 pounds of AXIS® Fine or Regular per square foot of surface area into the top 4" to 6" of soil.

For rooftop gardens and flower beds:
Rototill or pre-mix 10% to 20% by volume of AXIS® Fine or Regular into the growing medium.

For shrubs, ornamentals, perennials:
Uniformly mix 10% to 20% by volume of AXIS® Regular with the soil from the plant hole. Backfill with the AXIS®/soil mix.

Trees, and urban trees:
AXIS® helps reduce the root-damaging "bath-tub" effect of trees planted in poor soil. Apply 10% to 20% by volume of AXIS® Regular to the backfill mix. Ask your AXIS® representative for additional details on ways to treat the "bath-tub" effect for urban tree plantings.

Interior plants, container plants:
To create an ideal potting soil, add 10% to 20% by volume AXIS® Regular.

AXIS® Technical Data

AXIS IS A **CALCINED** DIATOMACEOUS EARTH PRODUCT

AXIS® REGULAR

TECHNICAL DATA

Bulk Weight	675 lbs./cubic yard
Bulk Density	0.40 g/cc
Spec. Gravity	2.20 g/cc
CEC	27 meq/100 g
Water absorption (ASTM F-726)	114%
Sulfate Soundness (ASTM C-86)	3% loss
Pore Size	0.1 - 1 micron
Total porosity	82%
pH	7

SCREEN ANALYSIS

On 6 mesh	5.0%
On 10 mesh	54.0%
On 20 mesh	87.0%
On 80 mesh	98.8%
Minus 80 mesh	0.2%

COMPOSITION

Calcined Diatomaceous Earth

Silica (SiO_2) approximately 90.0%

AXIS® FINE

TECHNICAL DATA

Bulk Weight	700 lbs./cubic yard
Bulk Density	0.42 g/cc
Spec. Gravity	2.20 g/cc
CEC	27 meq/100g
Water absorption (ASTM F-726)	142%
Sulfate Soundness (ASTM C-86)	7% loss
Pore Size	0.1 - 1 micron
Total porosity	81%
pH	7

SCREEN ANALYSIS

On 20 mesh	2.0%
On 80 mesh	99.5%
Minus 80 mesh	0.5%

COMPOSITION

Calcined Diatomaceous Earth

Silica (SiO_2) approximately 90.0%

Technical Data reported is typical

AXIS®

CALCINED DIATOMACEOUS EARTH
SOIL AMENDMENT

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