



Tenagreen Series

**Ceramic process cost
and tile flexibility**

Range of binders/plasticizers
for ceramic body composition



What Tenagreen is and does?



Products designed to enhance mechanical characteristics of the body before firing.



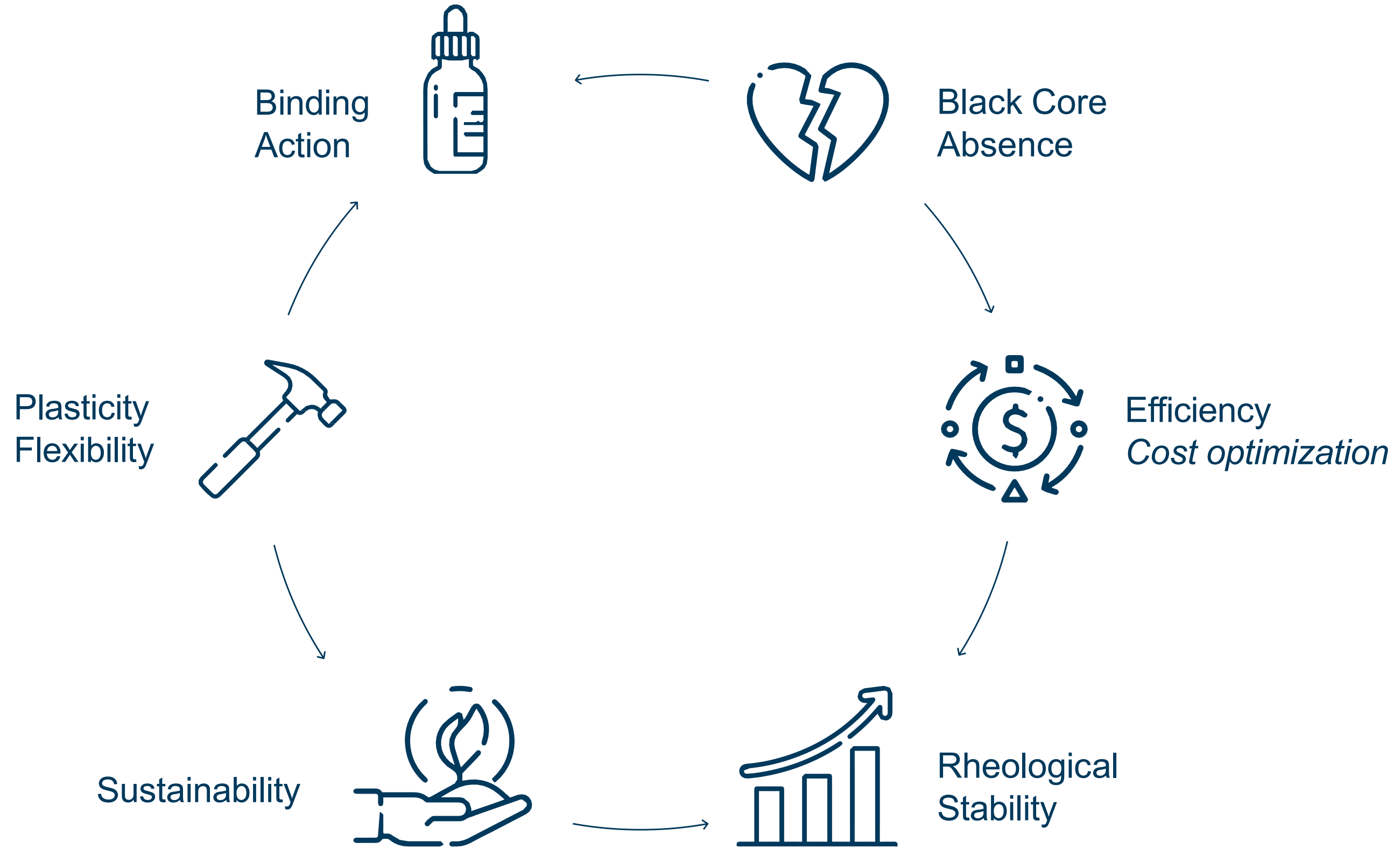
It combines production benefit for output quantity and sustainable solutions.



It's a blend of new generation resin from Lamberti technology.



Tenagreen Action Areas





Tenagreen Action Areas

Binder/plasticizer for the body to increase mechanical strength.



Binding Action

High mechanical strength values (high binding action):

- Less breakage
- Higher productivity
- Thinner tiles
- Slabs production



Plasticity Flexibility

High green strength values (high Plasticity):

- Less breakage
- Body Reformulation
- Punch/mould pressure reduction



Black Core Absence

Low impact on black core permits:

- Low organic matter content
- Complete burning of Tenagreen



Tenagreen Action Areas

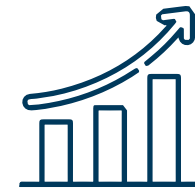
Binder/plasticizer for the body to increase mechanical strength.



Efficiency Cost Optimization

By the choice of the right Tenagreen is possible to:

Increase the ceramic process efficiency increasing the productivity reducing the body formula cost



Rheological Stability

A better rheological control brings:

- Low slip Viscosity
- Low slip yield point
- Low Thixotropy



Eco –compatibility

Tenagreen brings :

- Acid emission reduction
- V.O.C. reduction
- Low odorigenous emission



Tenagreen for all needs

Tenagreen FL

Blend of liquid binders
and deflocculants

Tenagreen N

Liquid Binders/Plasticizers

Tenagreen P

Binders/Plasticizers
in powder

Tenagreen S

Liquid Binders/Plasticizers
for particular production
necessities and for high frit
content body



What can be done with Tenagreen S?

Optimize ceramic process cost and increase productivity yield enhancing working density.

Increase tile Flexibility allowing production to be more stable and reducing scraps.



Tenagreen S serie

Effect on ceramic process

How tenagreen optimise costs and reduce environmental impact

Plastic clays are one of the main components of a ceramic body. However, although they ensure suitable mechanical properties, their presence limits production yield as they require larger quantities of milling water.

Plasticizers are used to reduce the plastic component and increase the content of lean clays, which are often cheaper and more readily available.

These additives achieve a number of goals:

- lower raw materials costs
- higher working density
- lower energy costs
- reduced CO2 emissions



Tenagreen S serie

Effect on ceramic process

Let's look at a practical example involving the introduction of a plasticizer from Lamberti's Tenagreen series (*fig.1*).

The most important targets:

1

Reduction in the cost of the ceramic body from 58 to 54 €/ton.

2

Natural gas savings of around 360 tons/year (about 490,000 m³/year) and a reduction in CO₂ emissions of about 900 tons/year; in addition to the economic savings (around €149,000 per year), the industrial-scale reduction in CO₂ emissions is also consistent with global decarbonisation climate plans.

3

Reduction in milling water consumption of 6,000 tons/ year.

		MOD1	MOD2
Plastic clay (%)	24	8	8
Other clays (%)	16	31	31
Tenagreen S (%)	-	-	0,6
Body Cost (€/t)	58	51	54
Density (gr/l)	1710	1750	1750
Spray dryer CH ₄ saving (ton/year)			-360 ton/year
Spray dryer CO ₂ saving (ton/year)			-905 ton/year
Viscosity (FC4mm)	22 sec	22 sec	22 sec
Green Mor (kg/cm ²)	8,2	7,6	7,6
Dry Mor (kg/cm ²)	35,0	20,0	35,0

Fig.1 Comparison between the composition of a standard body and one containing Tenagreen S



Tenagreen S serie

Effect on ceramic process

The graph (fig.2) shows how increasing slip density, reduces CH4 and CO2 consumption keeping an equal rate of productivity, on a year basis.

We considered a production of spray-dried material of 140,000 tons/year with a 6% moisture content.

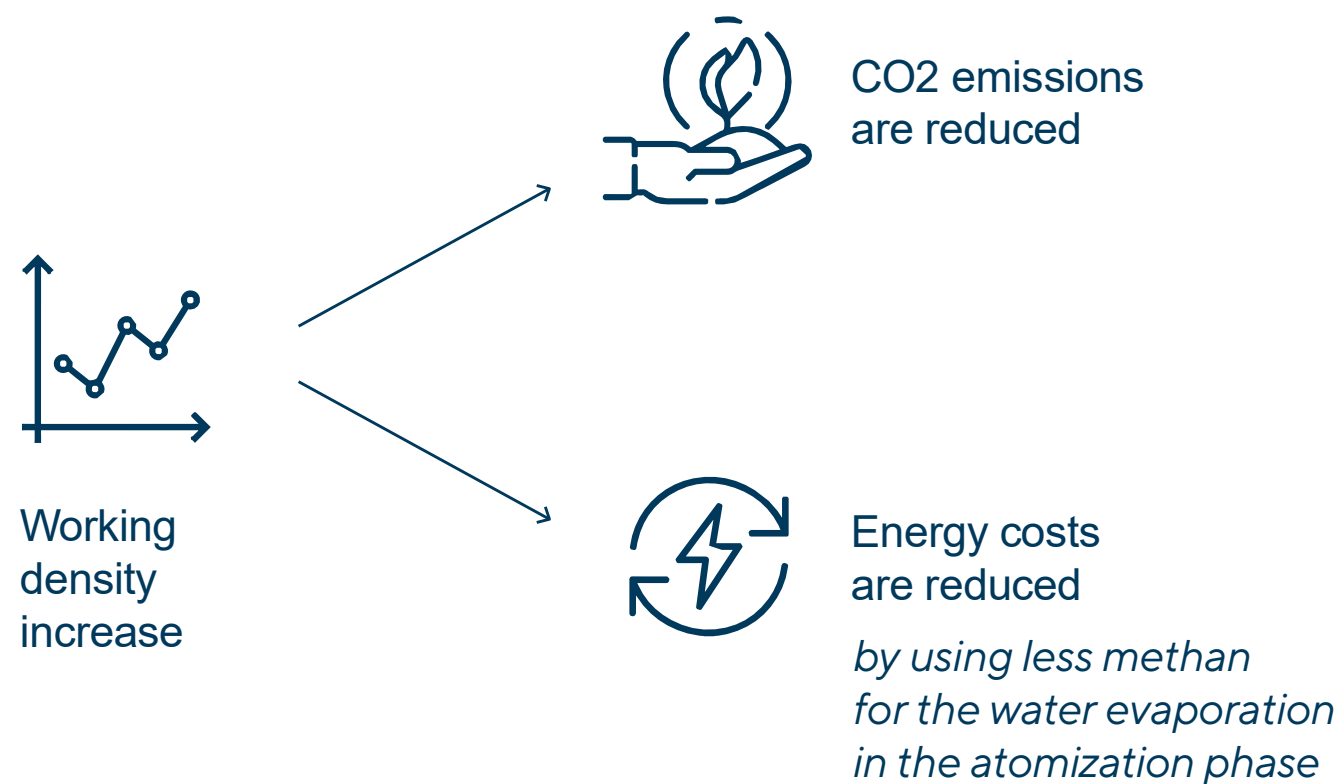
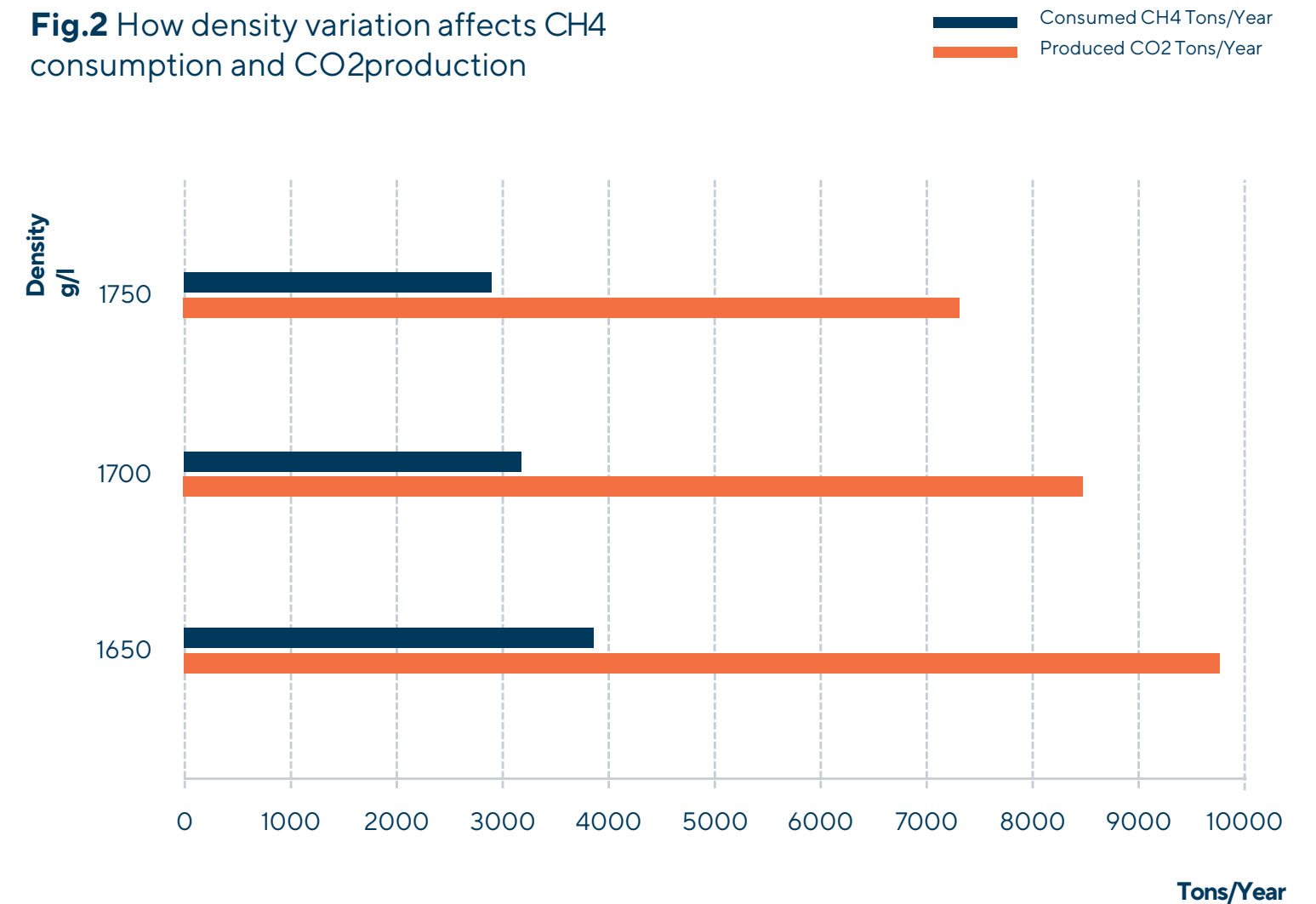


Fig.2 How density variation affects CH4 consumption and CO2 production





Tenagreen S serie

Effect on ceramic process

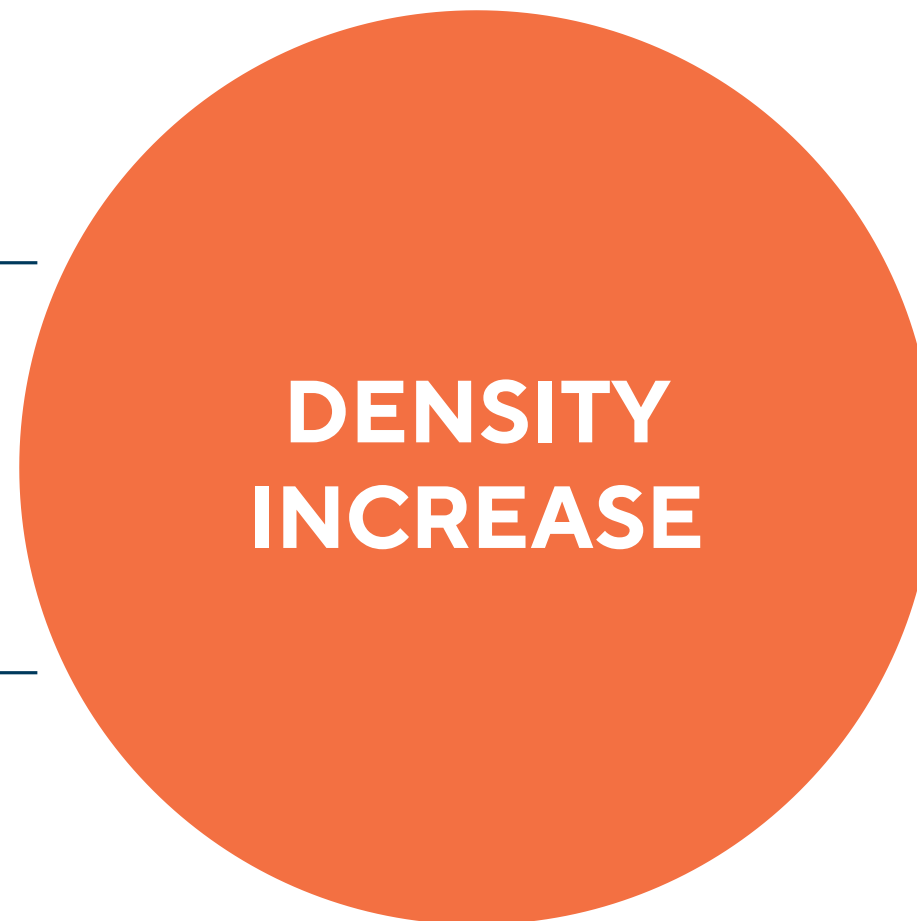
Let's sum up what it means **increasing the working density** for a ceramic process

Water Saving

We use less water into the milling process.

CO2 emissions decreasing

We produce less CO2 as we decrease keeping a steady productivity.



Methane CH4 saving

We use less Methane gas for the water evaporation.

Money saving

We save money as the usage of Methane gas is lower.



Tenagreen S

Effect on Flexibility

Deformation before breakage

By universal testig machine (picture on the right) it's possible to collect data on deformation before breakage, mechanical strength, modulus of elasticity and integrate them into a graph. All the samples have to be prepared by using accurately the same method (samples with the same moisture, mould pressure , drying temperature, storage time etc.)





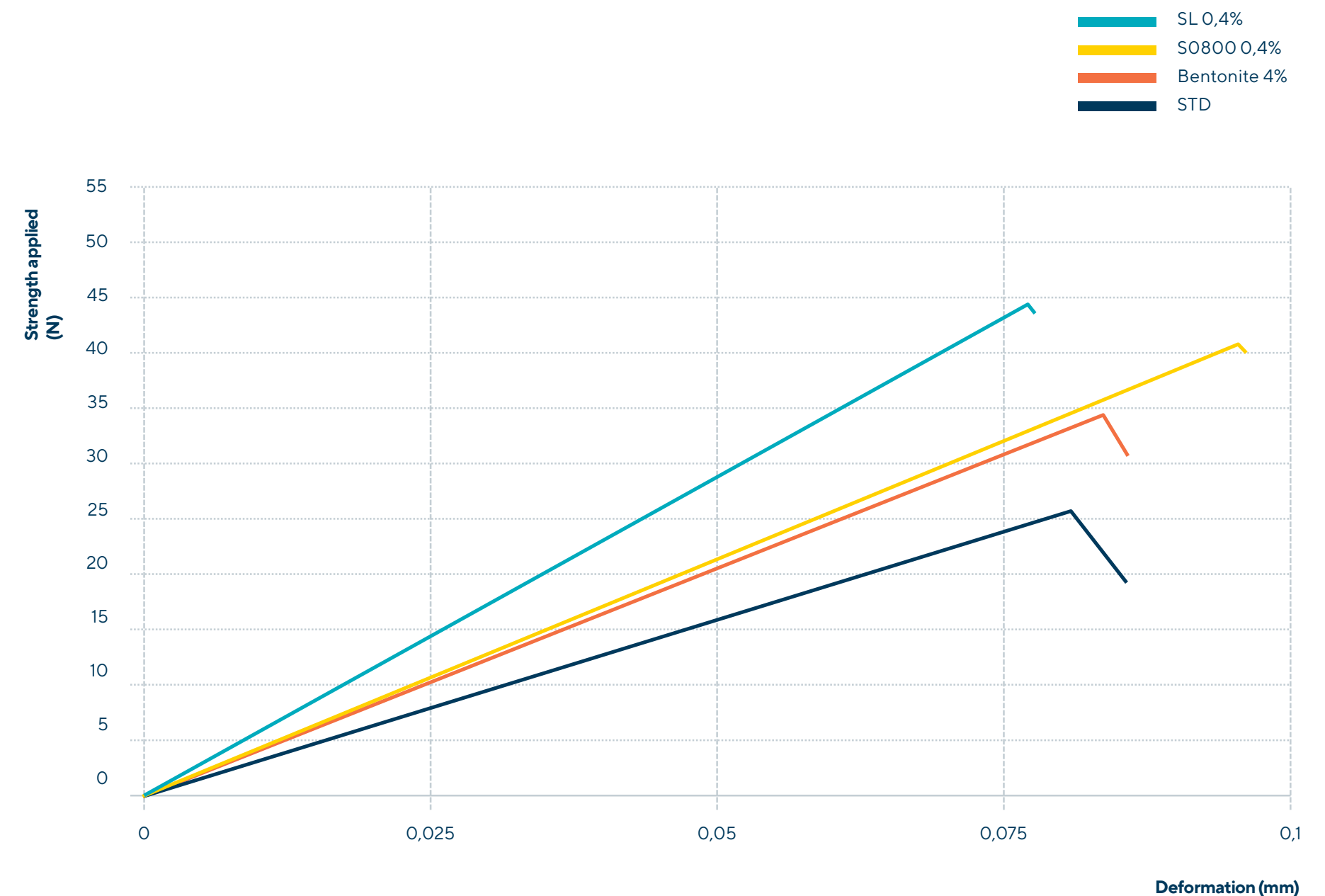
Tenagreen S

Effect on Flexibility

Deformation before breakage

Tiles more flexible accept a bigger deformation before breaking, avoiding defects as ruptures and cracks.

	STD	Bentonite 4%	Sulfonates 0,4%	Tenagreen S 0800 0,4%
Strength applied (N)	26,17	36,49	43,91	40,54
Deformation before breakage (%)	1,02	1,13 (+11%)	1,04 (+2%)	1,37 (+34%)





Tenagreen S Effect on Flexibility Deformation before breakage

On the way to get the mechanical strength measurements, it's possible to obtain the deformation before breakage as well. (fig. 3)
This deformation is calculated by detecting the displacement of a static extensometer applied to the specimen; this measurement is taken from the first Strength applied, thus the first movement of the specimen. **The deformation before breakage is calculated by the following expression:**

$$D = \frac{d^*}{e^{**}} \cdot 100$$

* Deformation before breakage
** Thickness of the sample

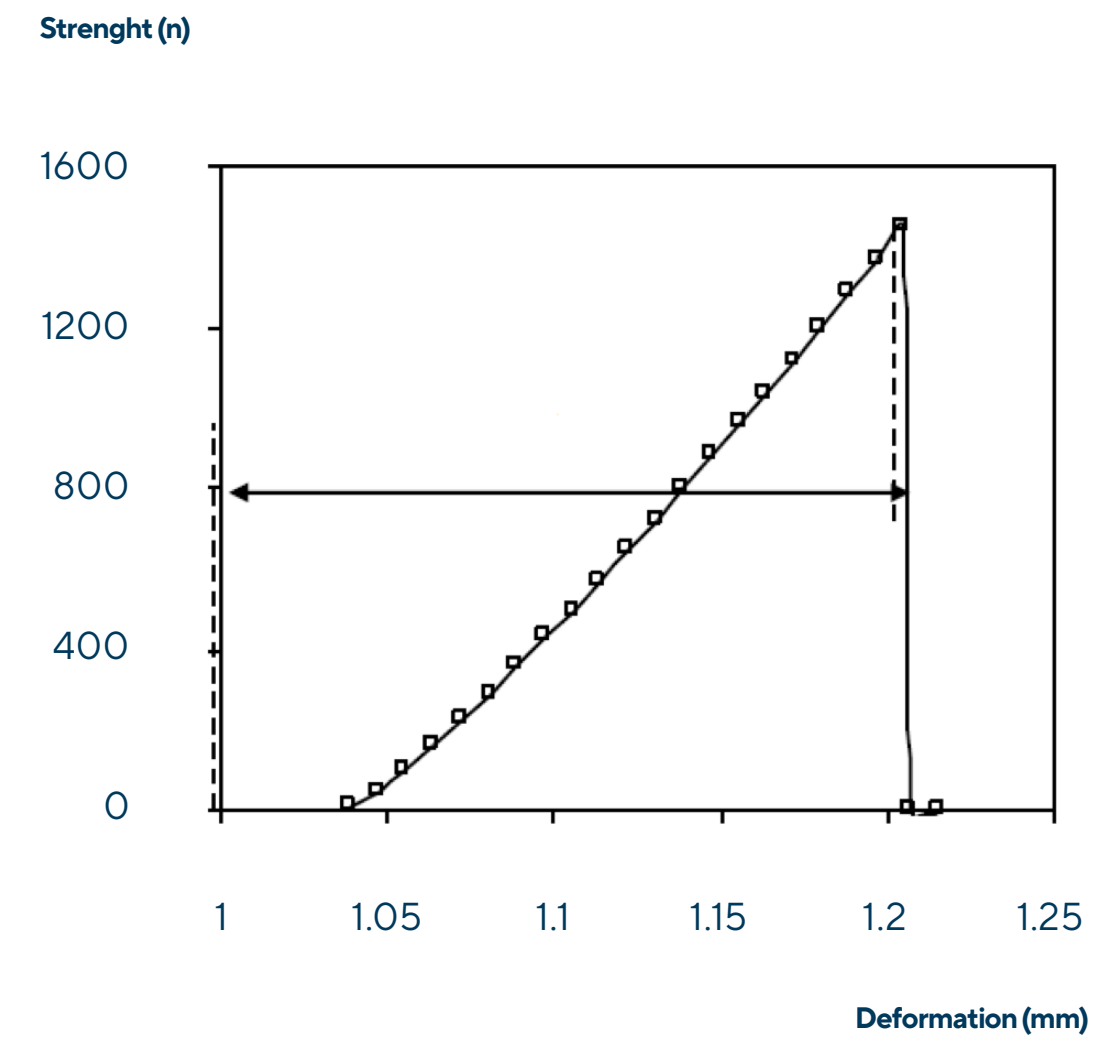
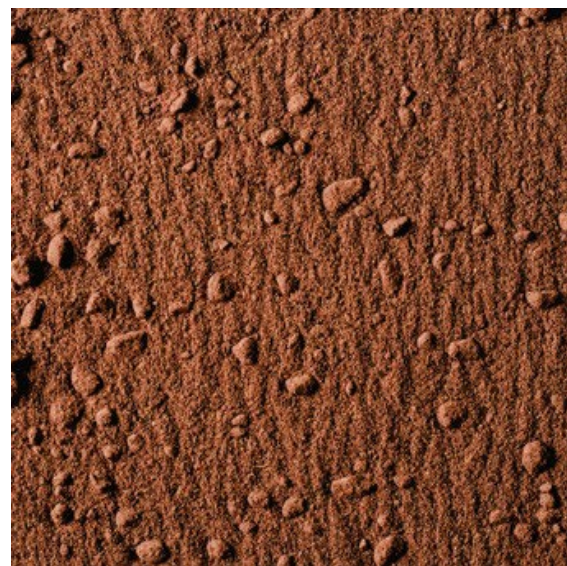


Fig.3 Relationship between growing strength applied and the consequent deformation of the specimen.



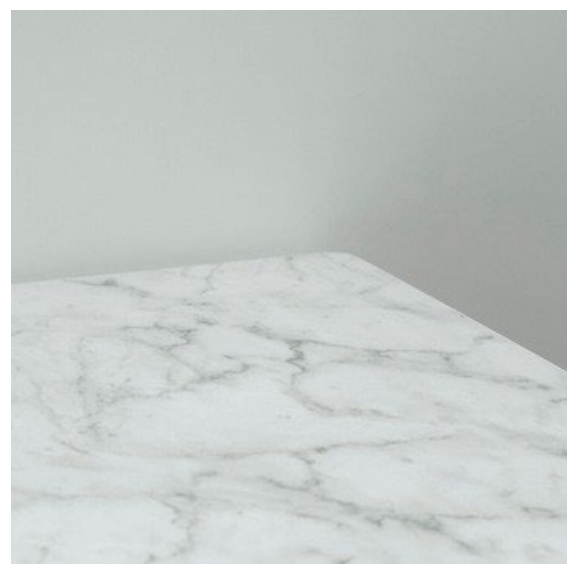
Tenagreen S

What technological changes can be supported?



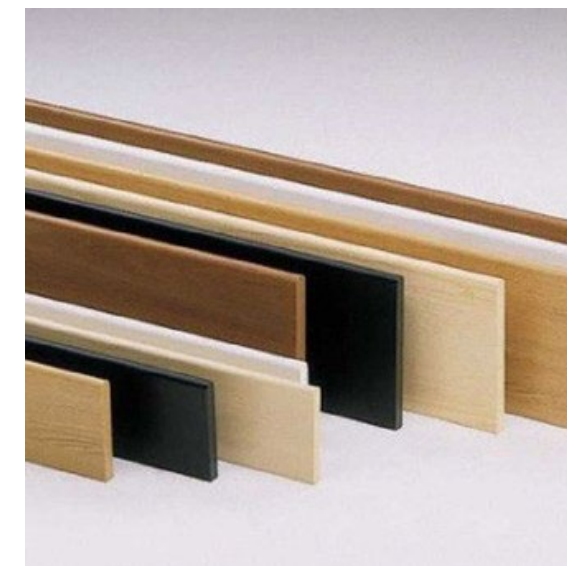
Replacing partially plastic clays

Tenagreen can help in recover part of the plasticity if a technologist reduces the content of plastic clay; no side effect are found as variations in dimension, water adsorption or planarity.



Produce Slabs

The internal slab strains can be reduced by supporting the body recipe with a plasticizer.



Reduce thickness

Tenagreen can help this technical change; the mechanical strength downs along with the thickness if all the other working parameters are the same.



Conclusions



Let's underline the targets by using Tenagreen S



The Flexibility of tiles and slabs is enhanced facilitating the technological innovation



The ceramic process can be optimized increasing productivity with low environmental impact

