A new empirical method to test Workability and Slip/Sag control of rheological additives in mortars

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Product Development Additives & Fillers TOLSA

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AGENDA

1- Introduction
2- Mineral thickeners gelling mechanism
3- Workability empirical method
4- Mineral Rheological additive compared with organic thickeners
5- Conclusions

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Introduction

- **Workability** is the property that defines how easy is to apply and place a mortar, either by hand or spray machine.

- **Workability** is a property commonly spoken in the mortar industry and highly appreciated by the workers, but has always been a quite subjective property.

- A **pseudoplastic** material decrease viscosity with the shear rate, thus improve workability.

Introduction

- A product with good workability saves time in its application, so **cost savings** are achieved.

- **Mineral rheological additives** (Special Clays) provide an important workability improvement, however there is not any standard method to test it.

- TOLSA has developed an internal **empirical method** to test workability and slip/ sag resistance.

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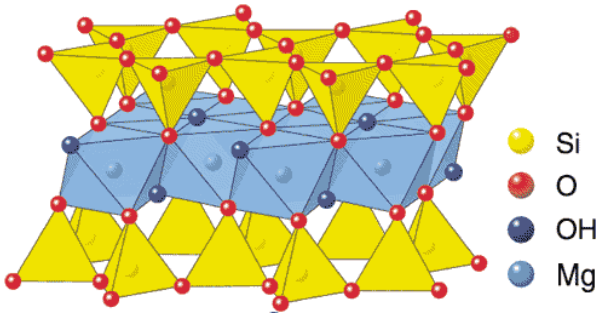
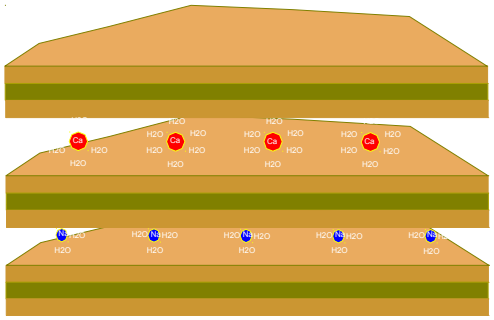
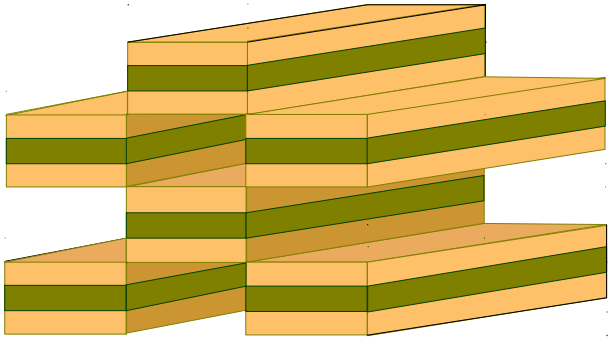
Clays Structure

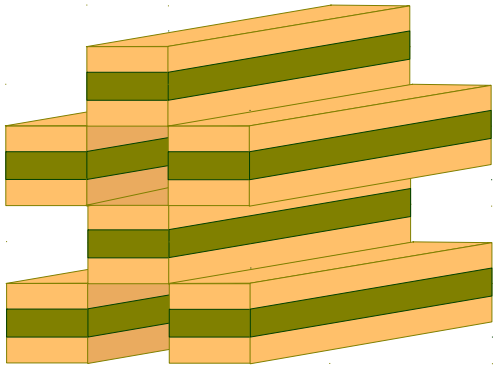




Smectites (Bentonites)



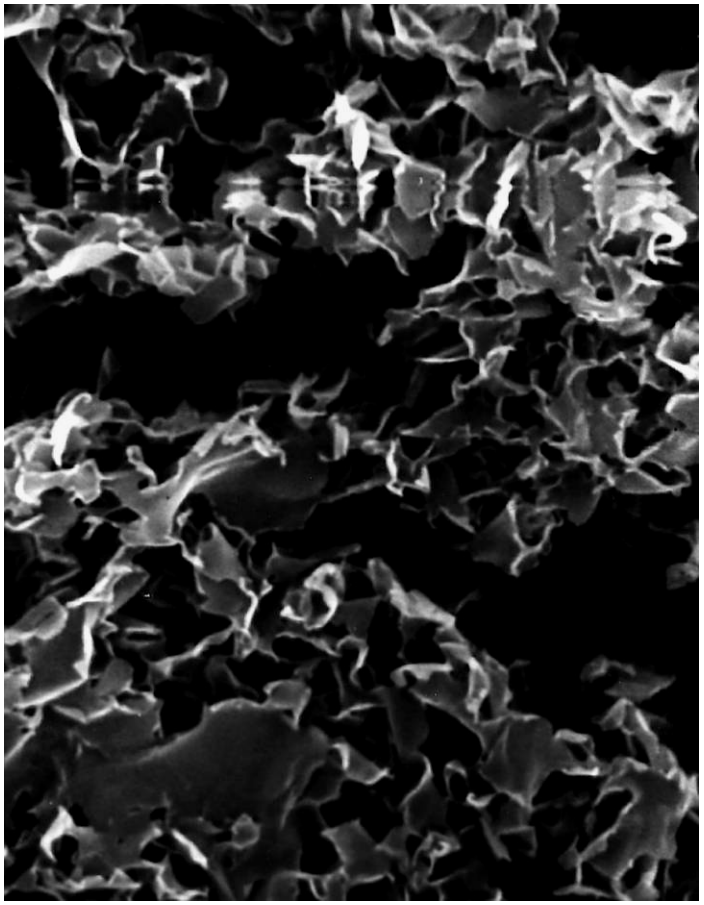
Sepiolite



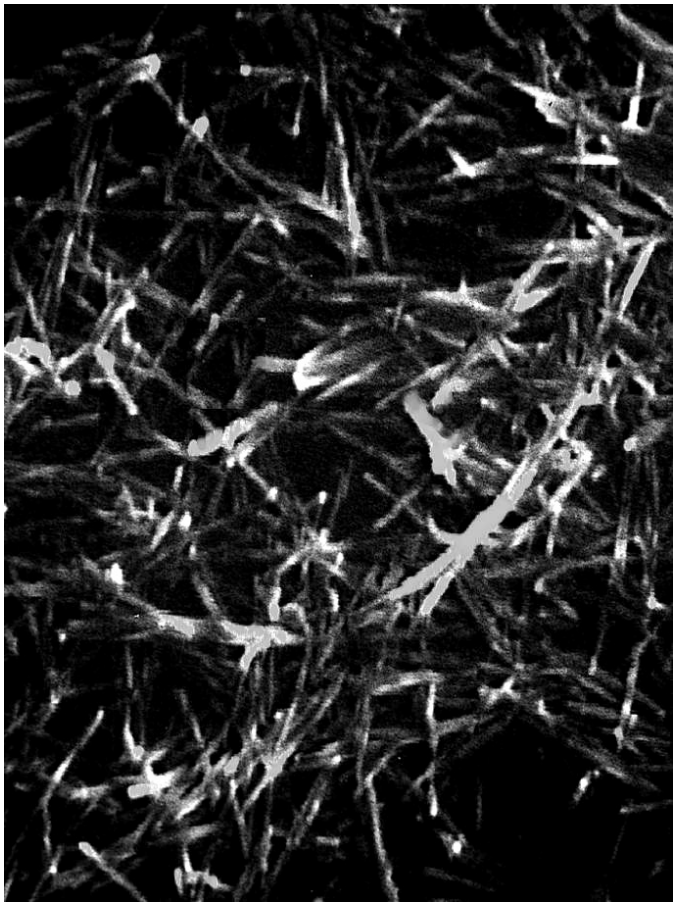
Attapulgite

TOLSA

Bentonite & Sepiolite

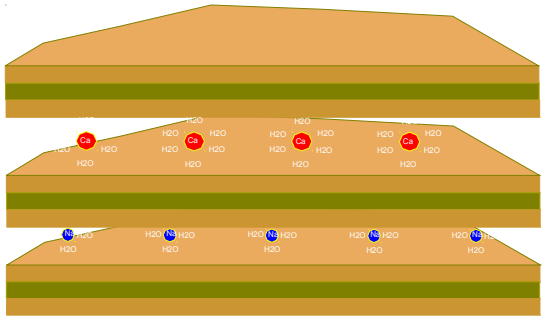


Bentonite (Smectites)

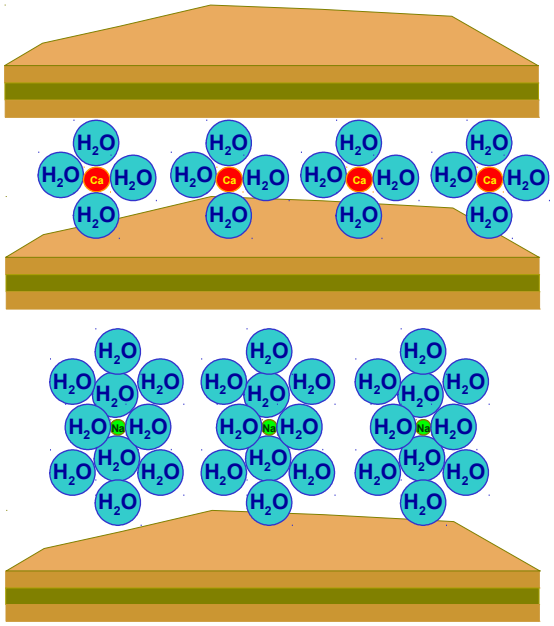


Sepiolite & Attapugite

Bentonites



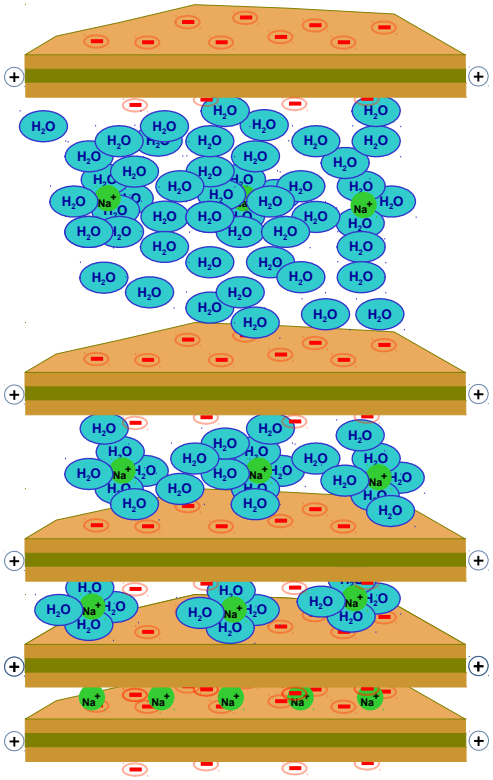
Swelling in presence of water

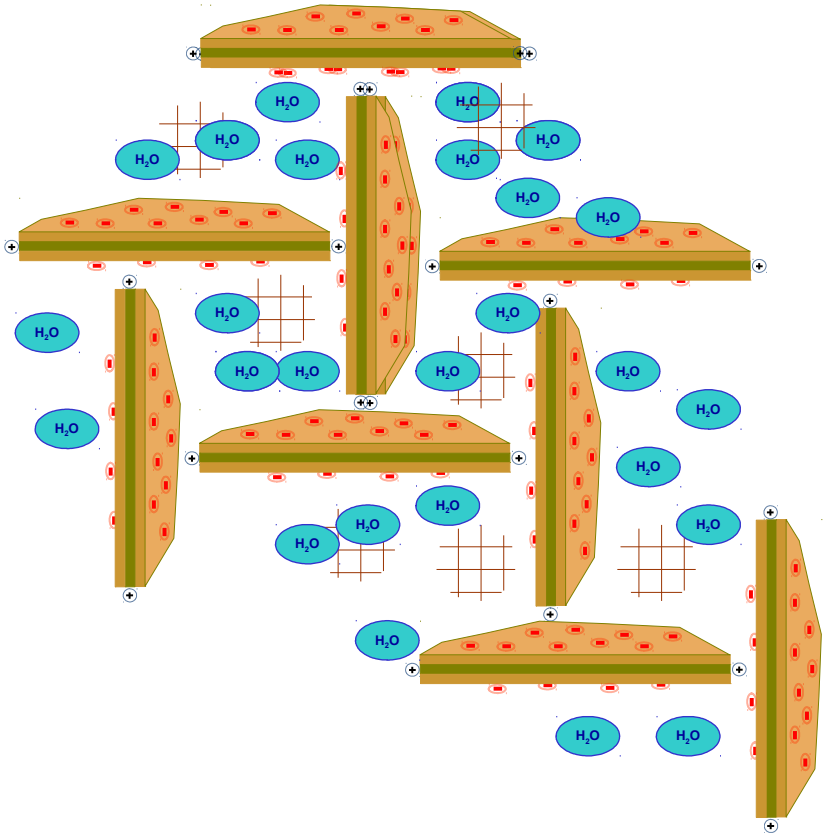


SMECTITES
(Bentonites)

A family composed of a variety of different minerals: Montmorillonite, Stevensite, Saponite or Hectorite, as main ones.

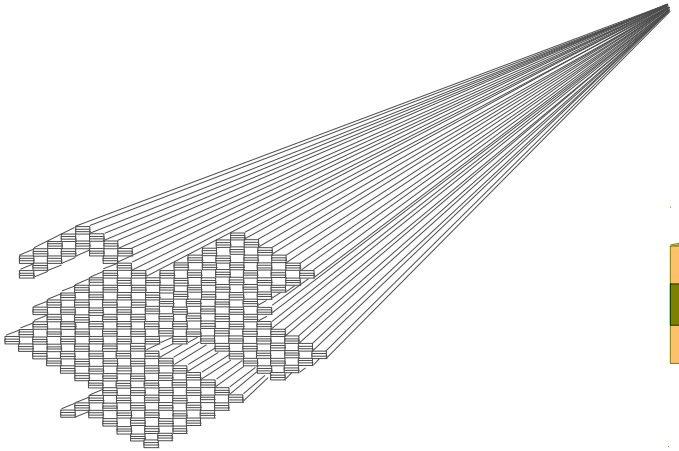
Smectites gelling mechanism

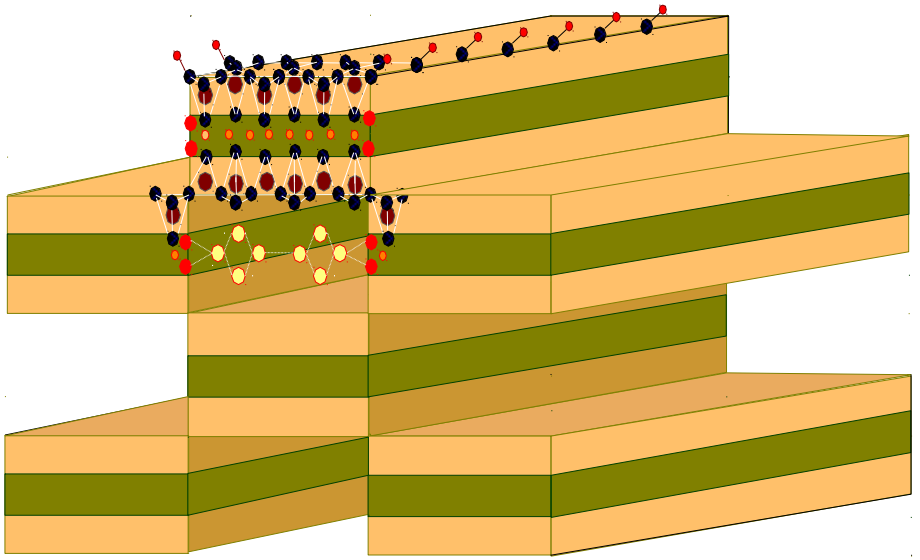




Sepiolite

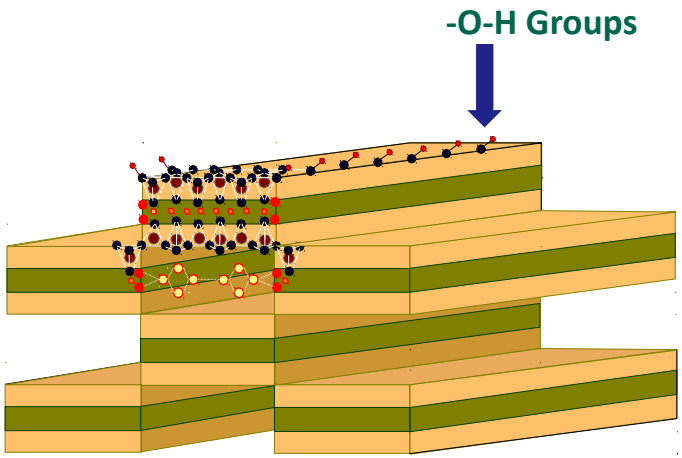
It is hydrated but it does not swell. It keeps a big surface highly covered with OH groups



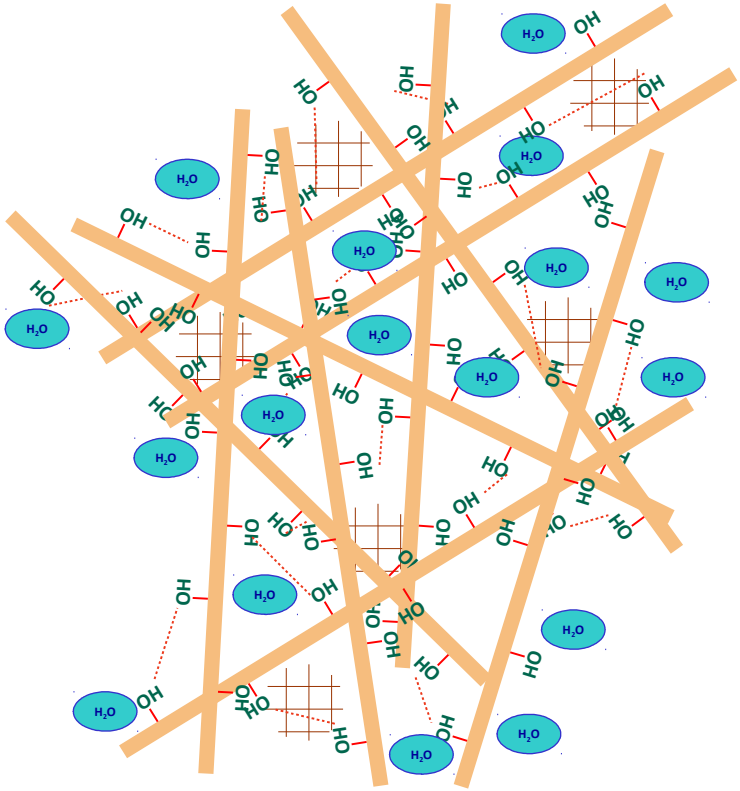


Attapulgite shares most of these properties

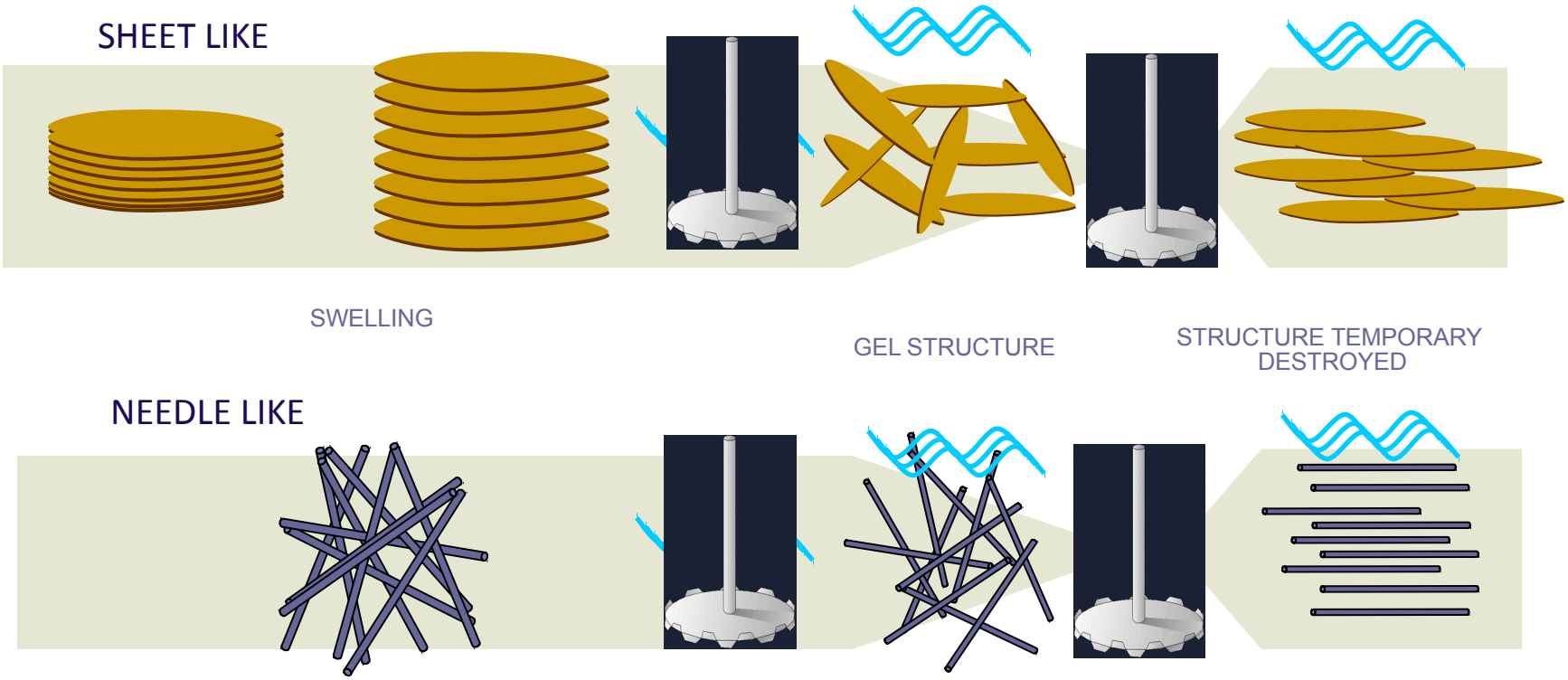
Sepiolite & Attapulgite gelling mechanism



Sepiolite basic structure



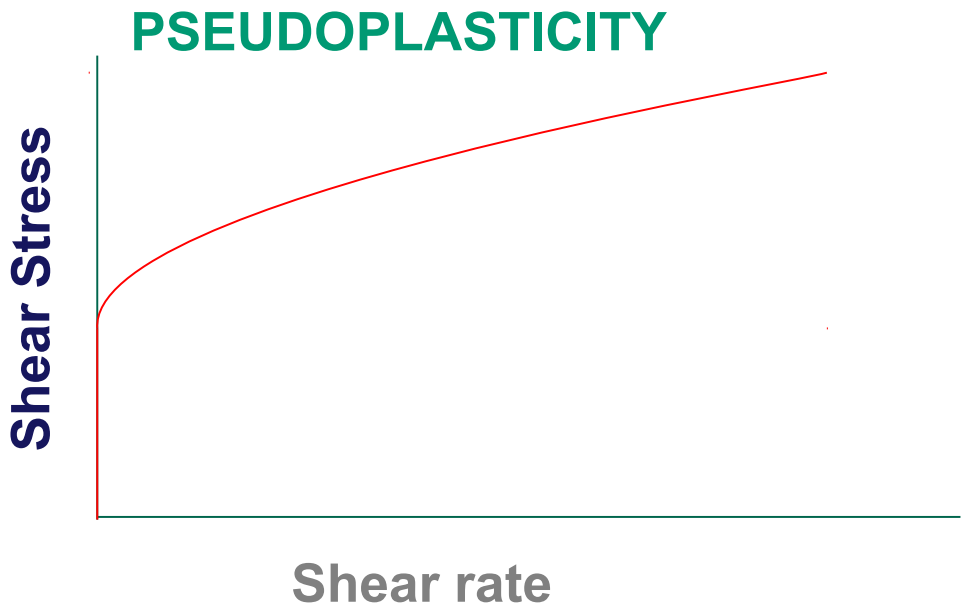
Clays Gelling Mechanism



Clays Gelling Mechanism (I)

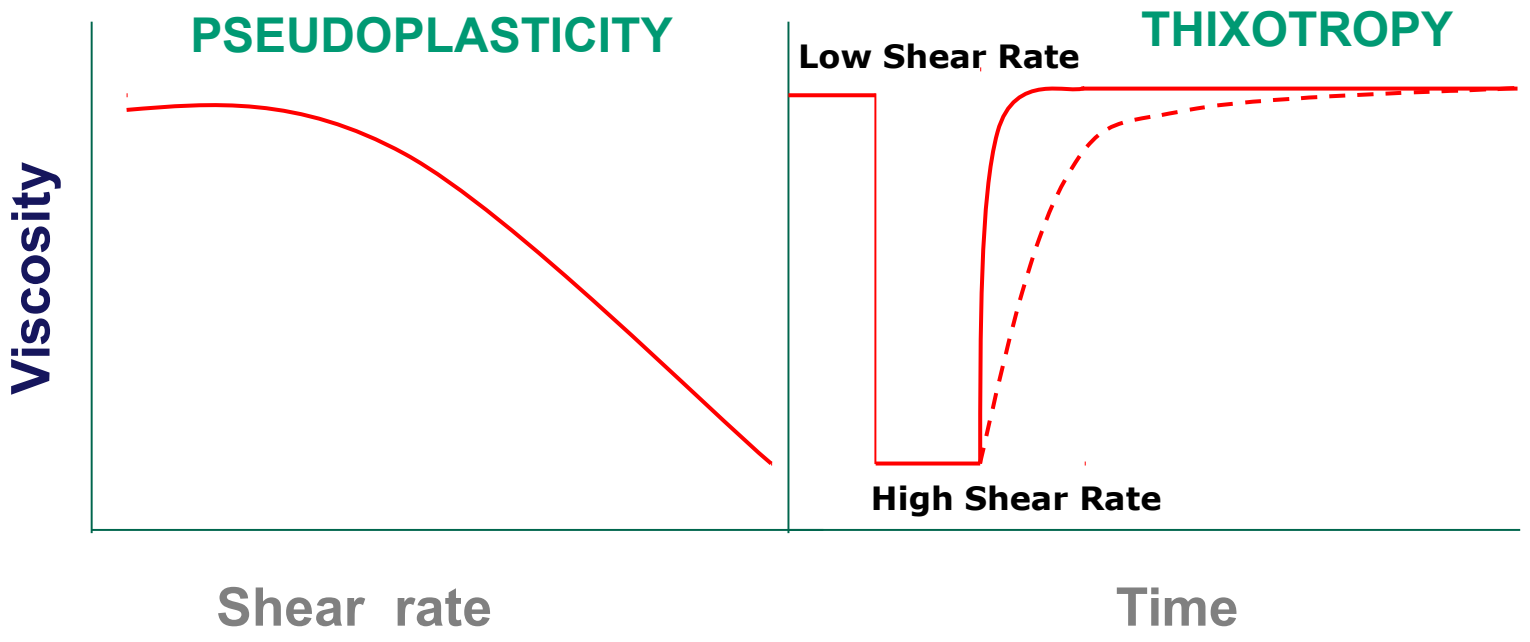
When mineral rheological additive is introduced and dispersed in mortar matrix it will form a gel structure, responsible of viscosity increasing and leading slip and sag resistance.

Mineral rheological additives are highly pseudoplastic products with excellent thixotropy based in different silicate minerals.



Clays Gelling Mechanism (II)

- ✓ High pseudoplastic leads an excellent control of sedimentation
- ✓ Excellent thixotropy allows to apply thick layer without sagging
- ✓ For comparable consistency better leveling



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Mortar Structure Break down

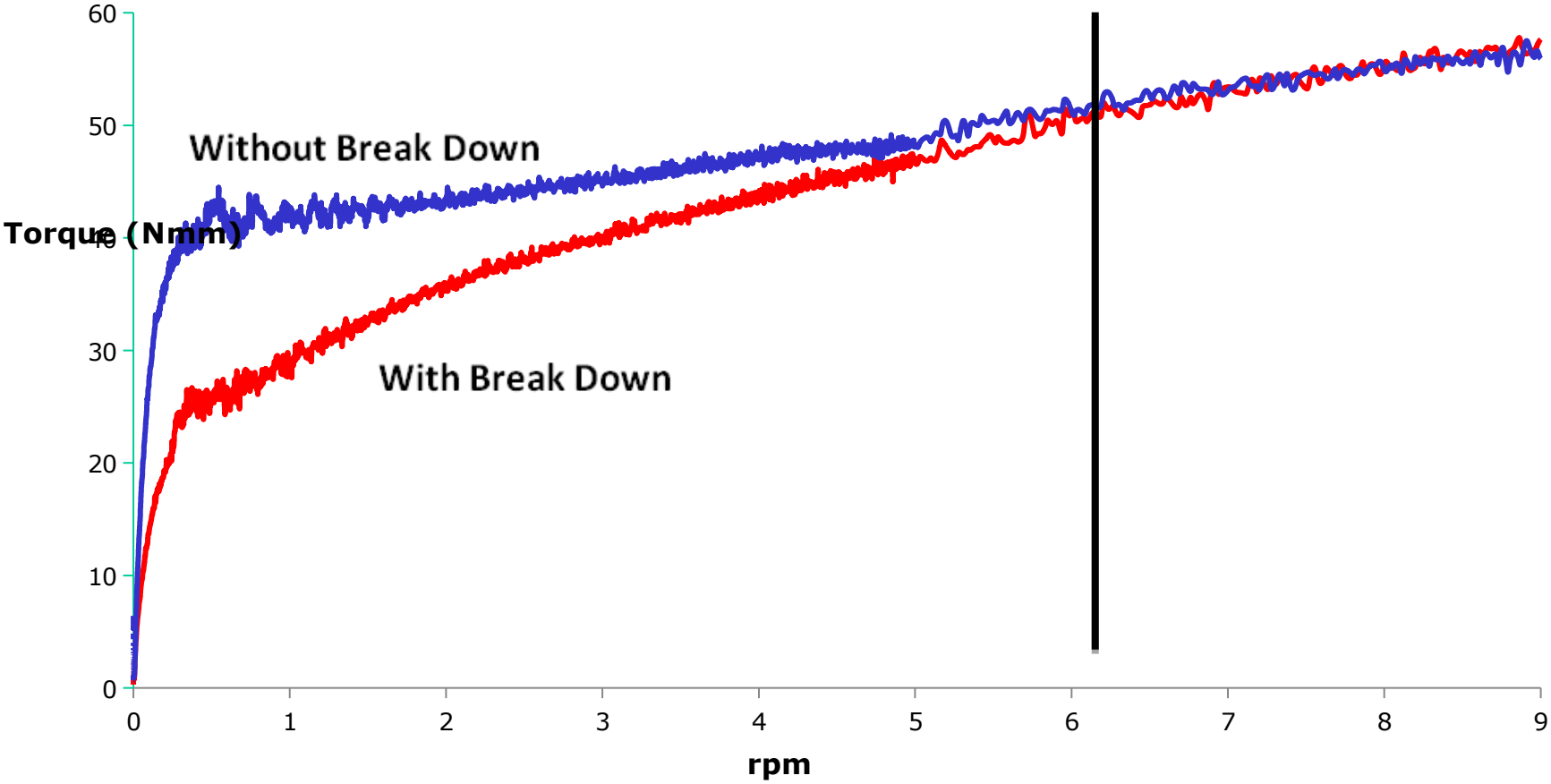
Is represented the **torque** or Shear stress versus Shear rate or rotational speed (**rpm**).

First of all in a new system is tested the same product with and without a break down:

- Without break down**:** 5´ at 0 rpm at the beginning.
- With break down: 5´ at 120 rpm at the beginning.

After these 5´ the same profile for both.

Rheograms Zones



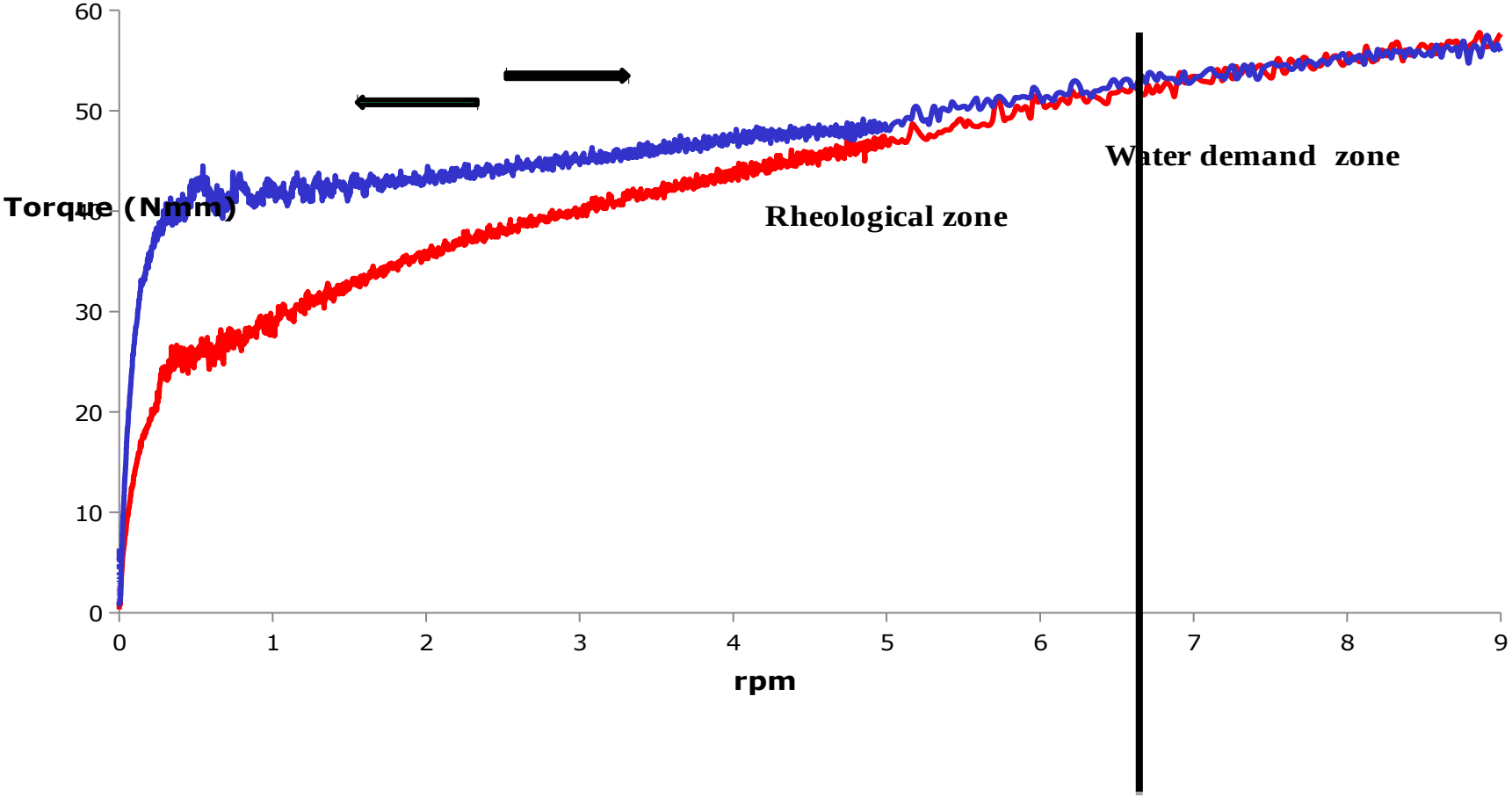
Rheograms Zones

Two well differentiated **zones** are observed in the rheogram:

1- The consistency or water demand zone or free water content zone

2- The gel structure or rheological zone

Rheograms Zones

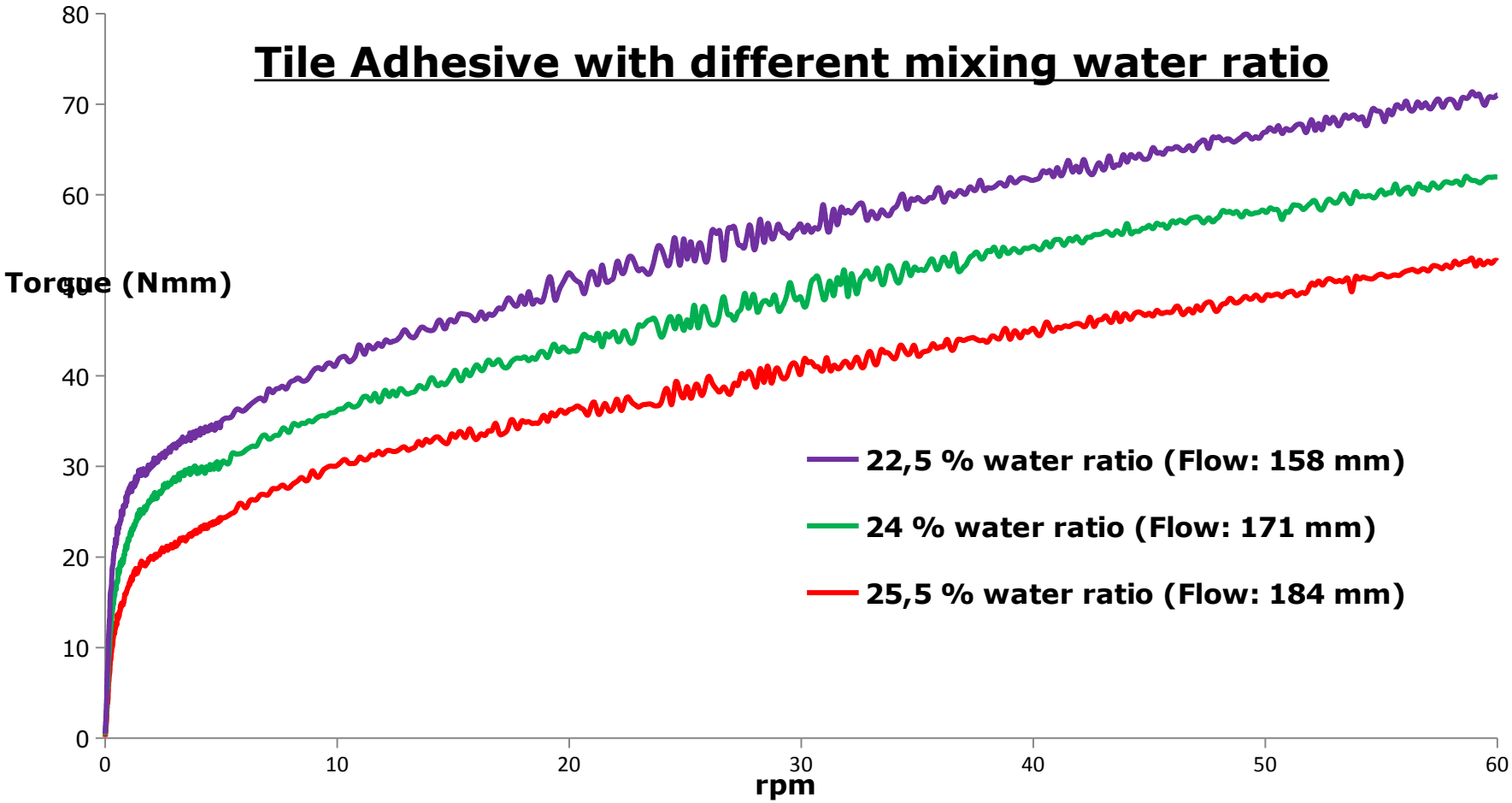


Rheograms Zones

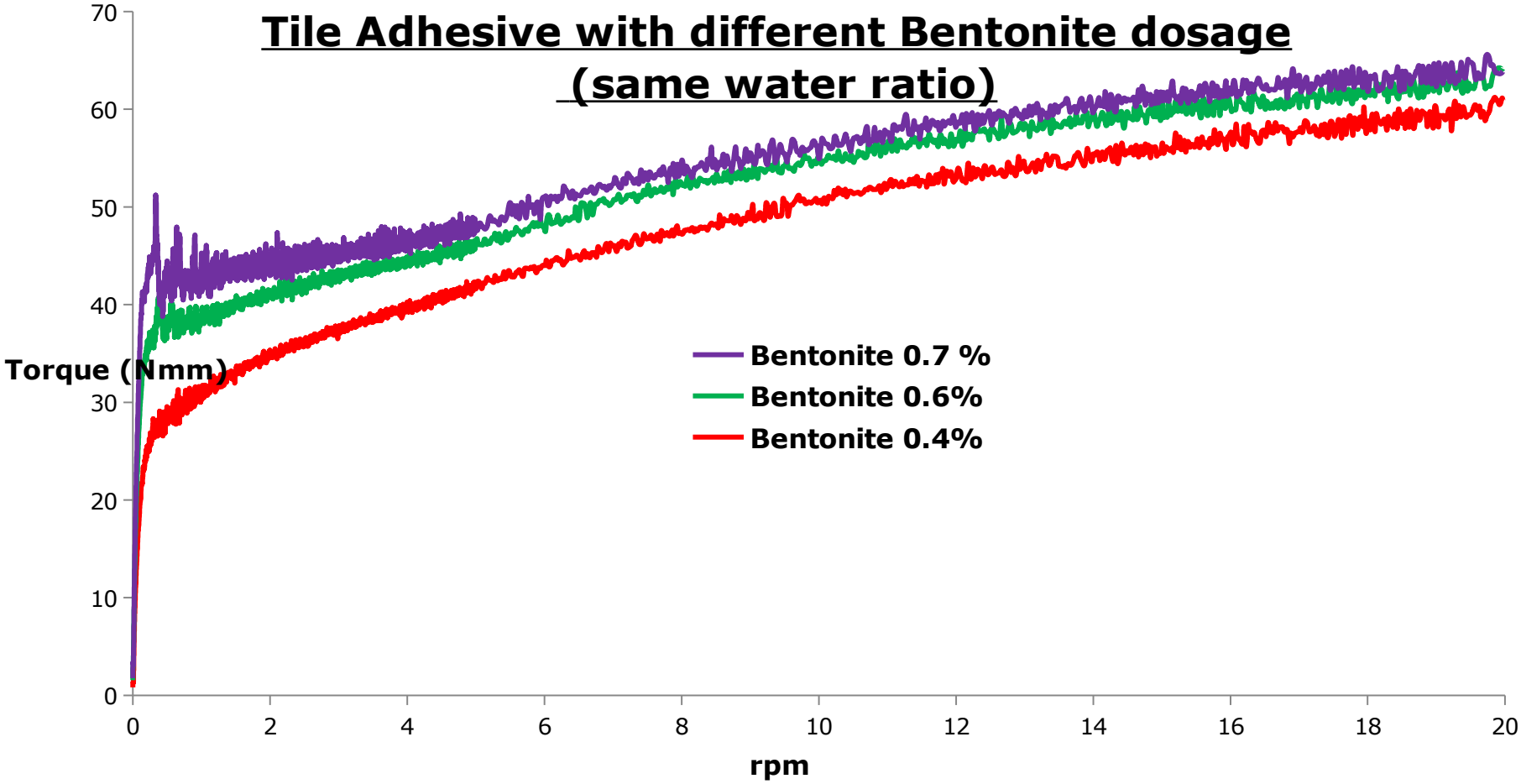
1- The consistency or water demand zone or free water content zone

- No interaction in the mortar matrix because the rheometer has broken them due to the shear rate.
- Torque depends on the mortar water demand or “free water available in the system”.
- Higher water demand means higher torque.

Water Free Rheogram Zone



Water Free Rheogram Zone



Rheograms Zones

2- The gel structure or rheological zone

- Assess resistance of the mortar matrix interaction to be sheared and how they are broken when the shear increase.

- Gel peak is linked with shear rate unique point, induced by mineral rheological additive.

Rheological additives comparison

Comparative between rheological additives

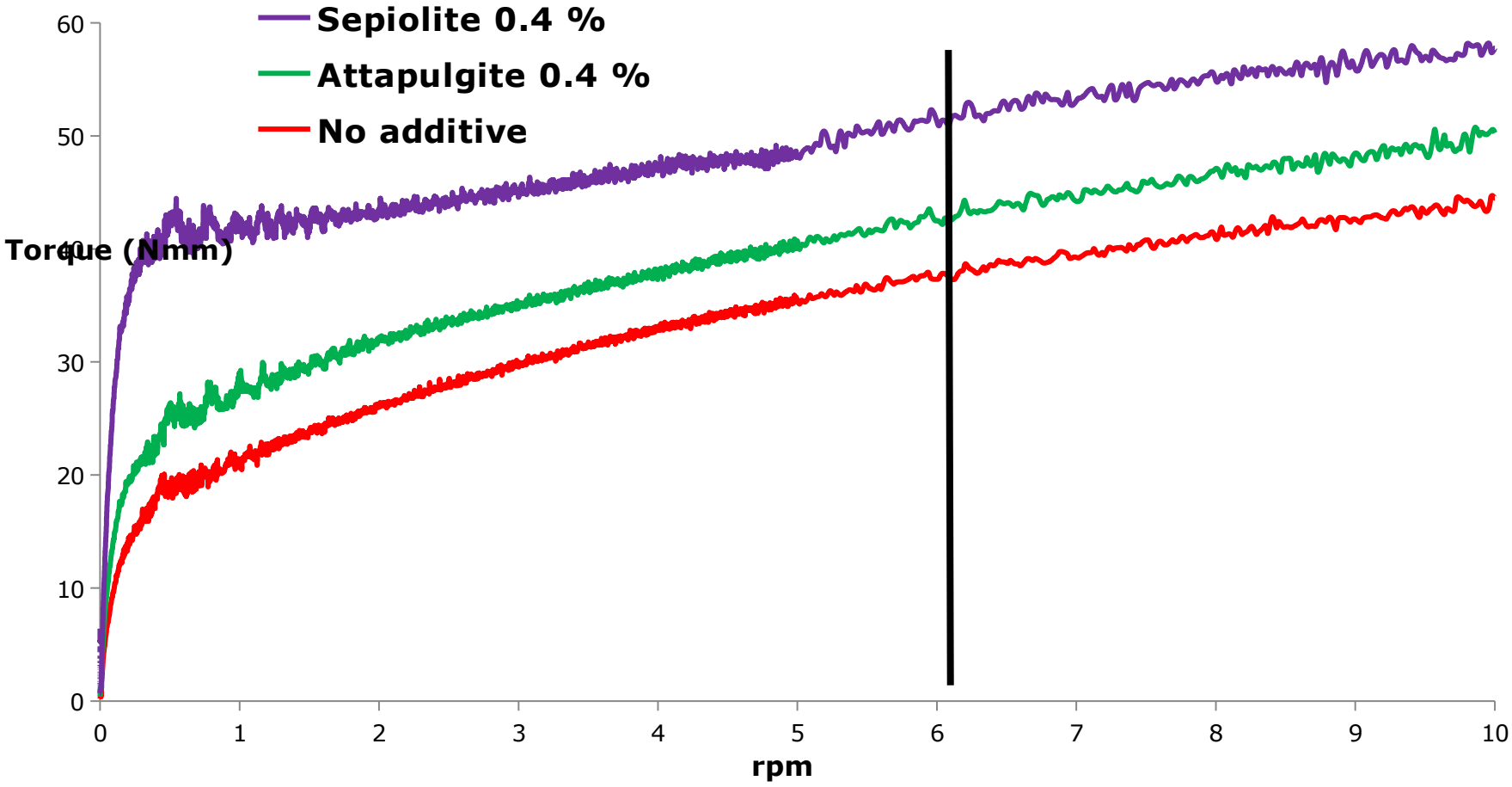
To be able to compare two graphs or products must have the same values in the water demand zone.

This could be or achieve modifying these two characteristics:

1- The rheological additive dosage.

2- The water dosage.

Rheological additives Comparison



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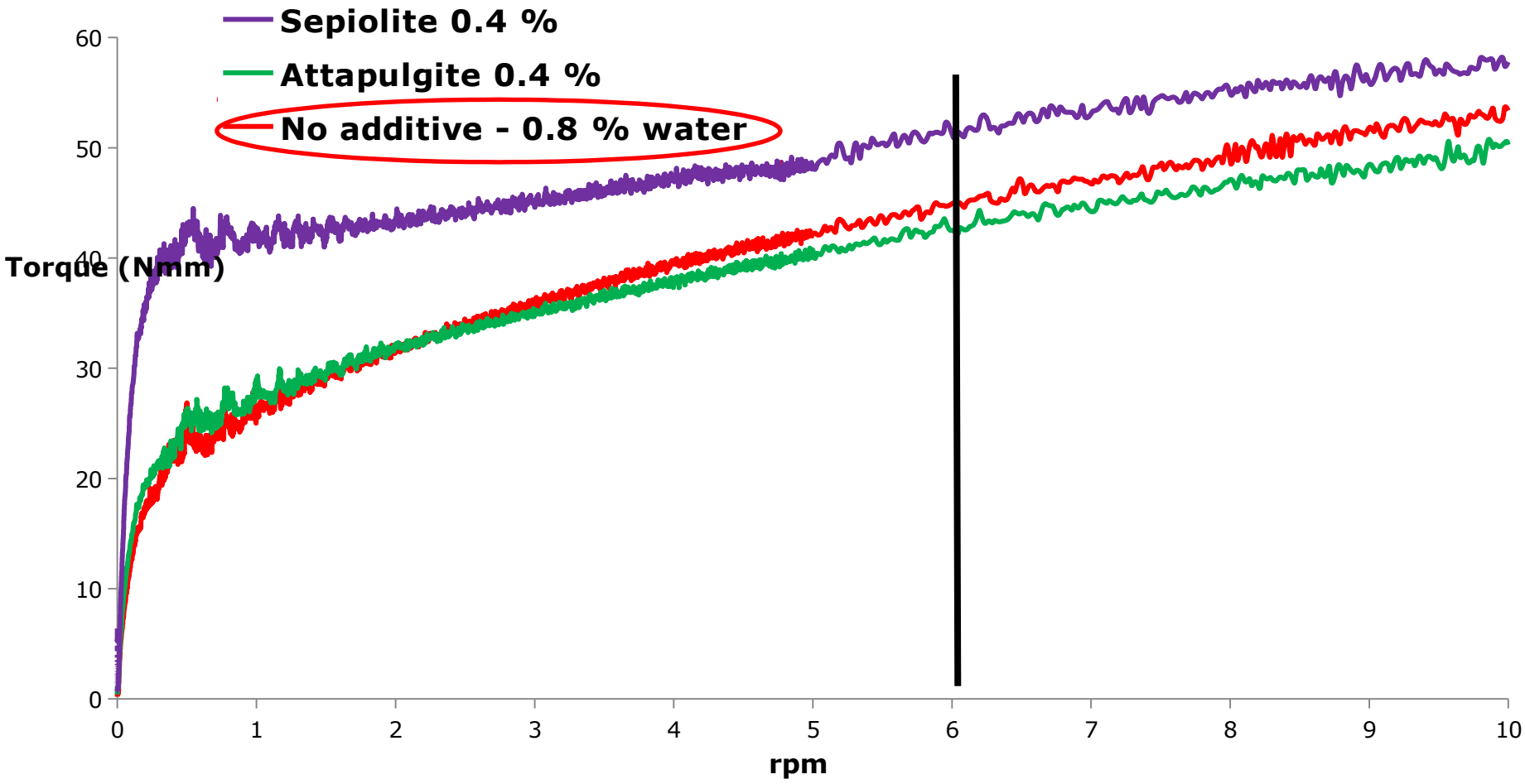

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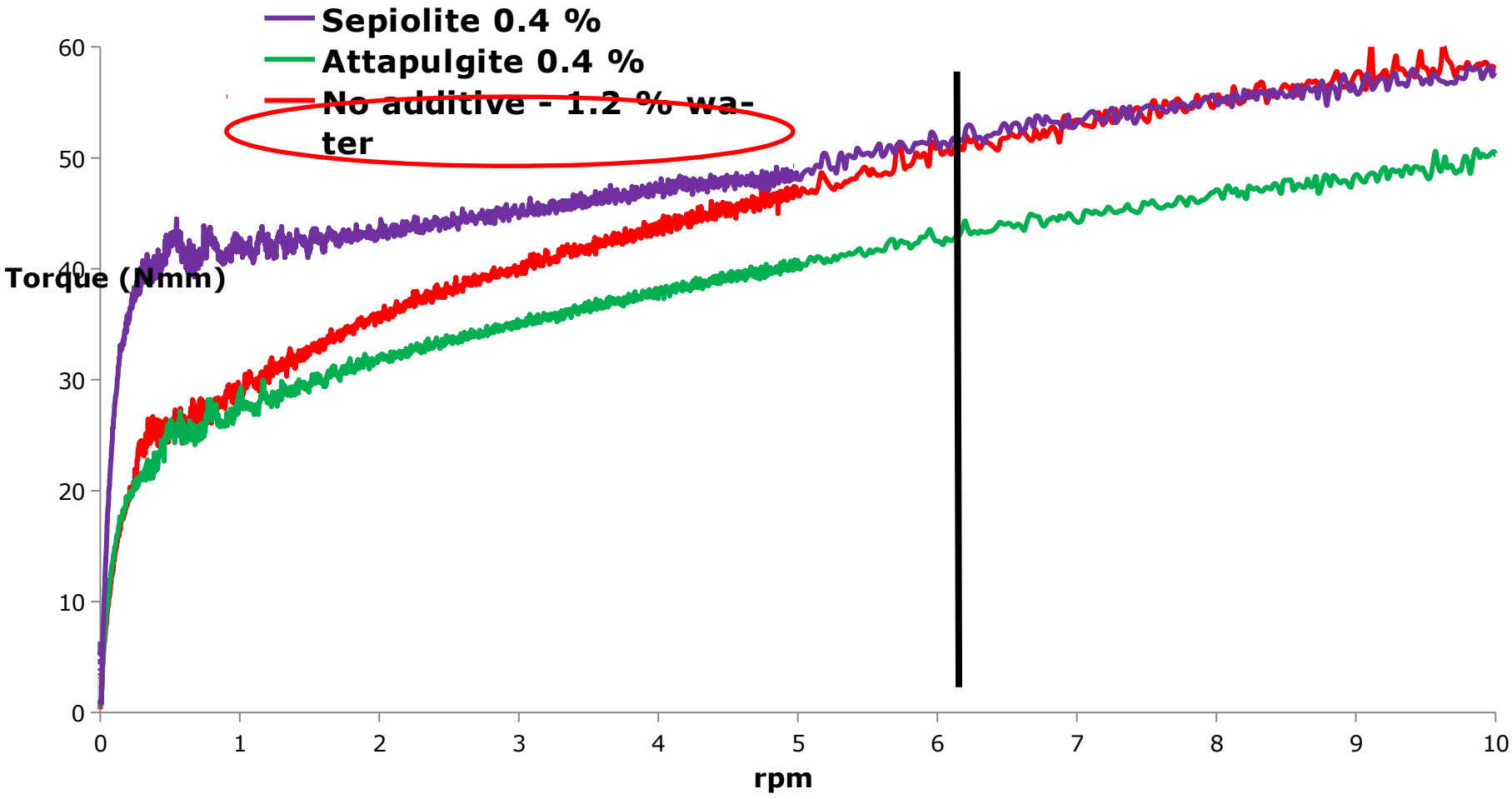

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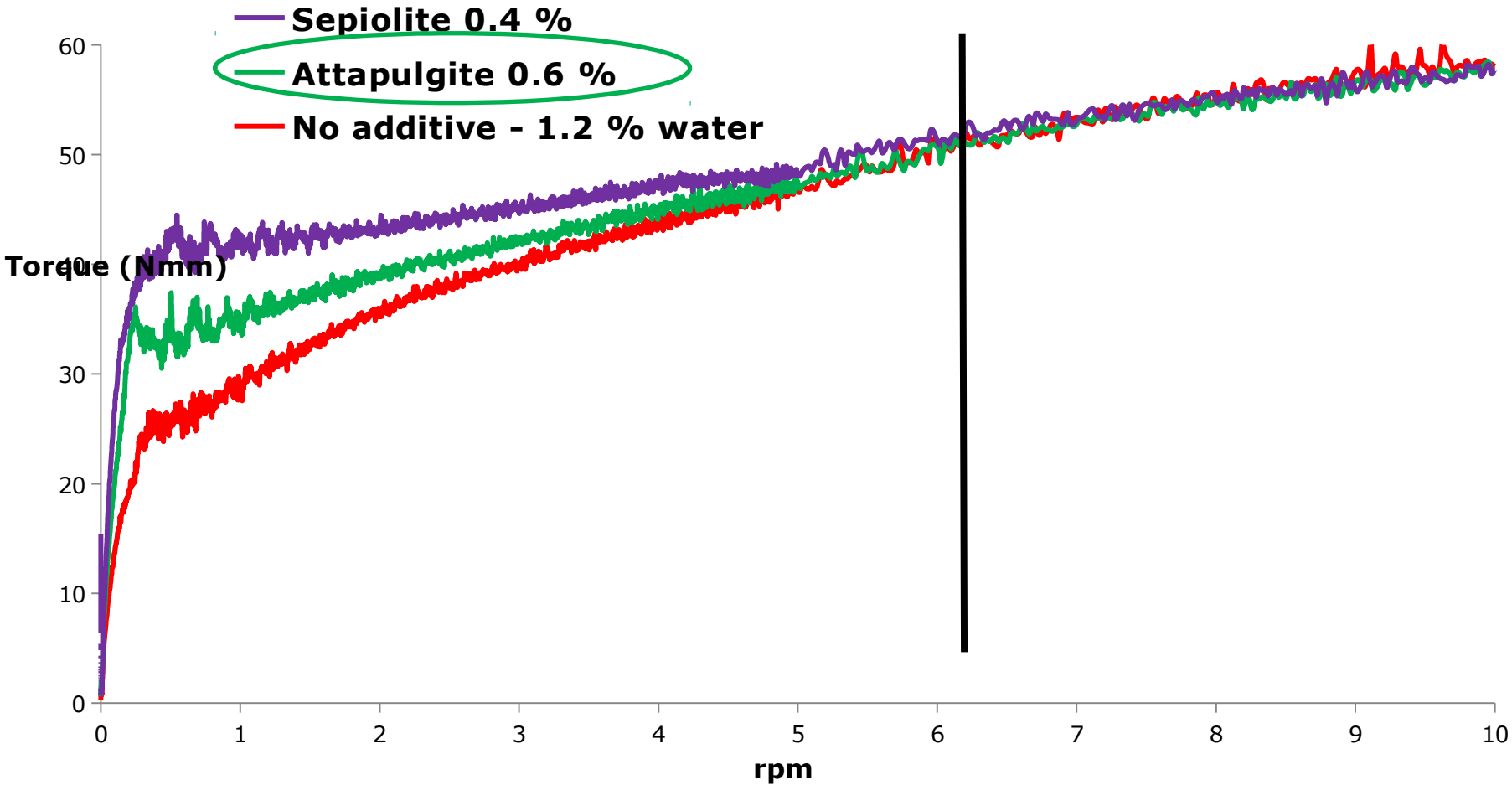


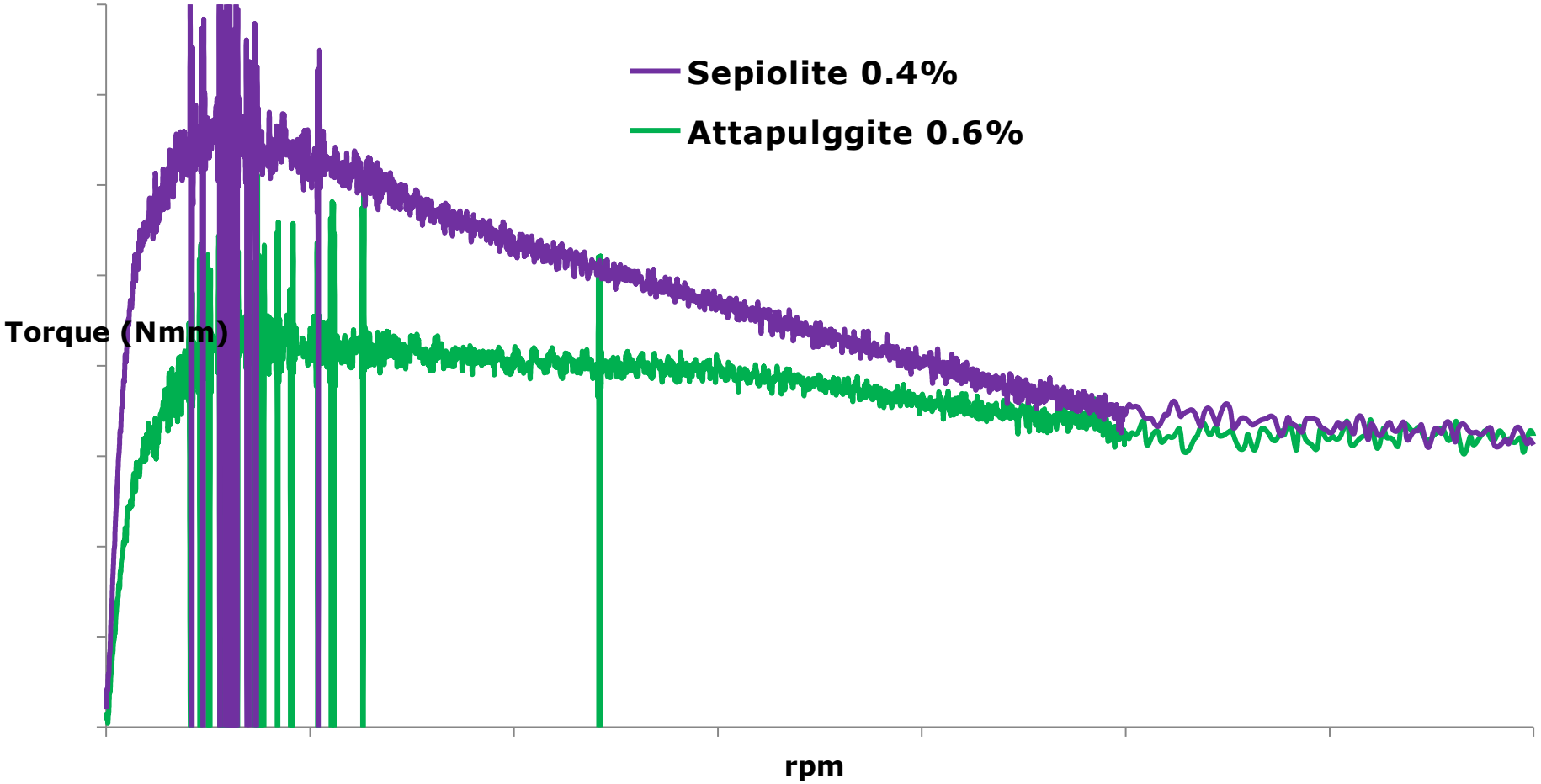
Net additive behaviour

- Net behavior of the rheological additives is subtracting to the sepiolite and attapulgite graph all— points of the control graph.

- Then is selected the shear rate at the maximum peak and is defined a vertical line call the **sag quantification line.**

- There is direct relation between this torque value and the slip/ sag resistance according to EN-1308.

Net additive behaviour



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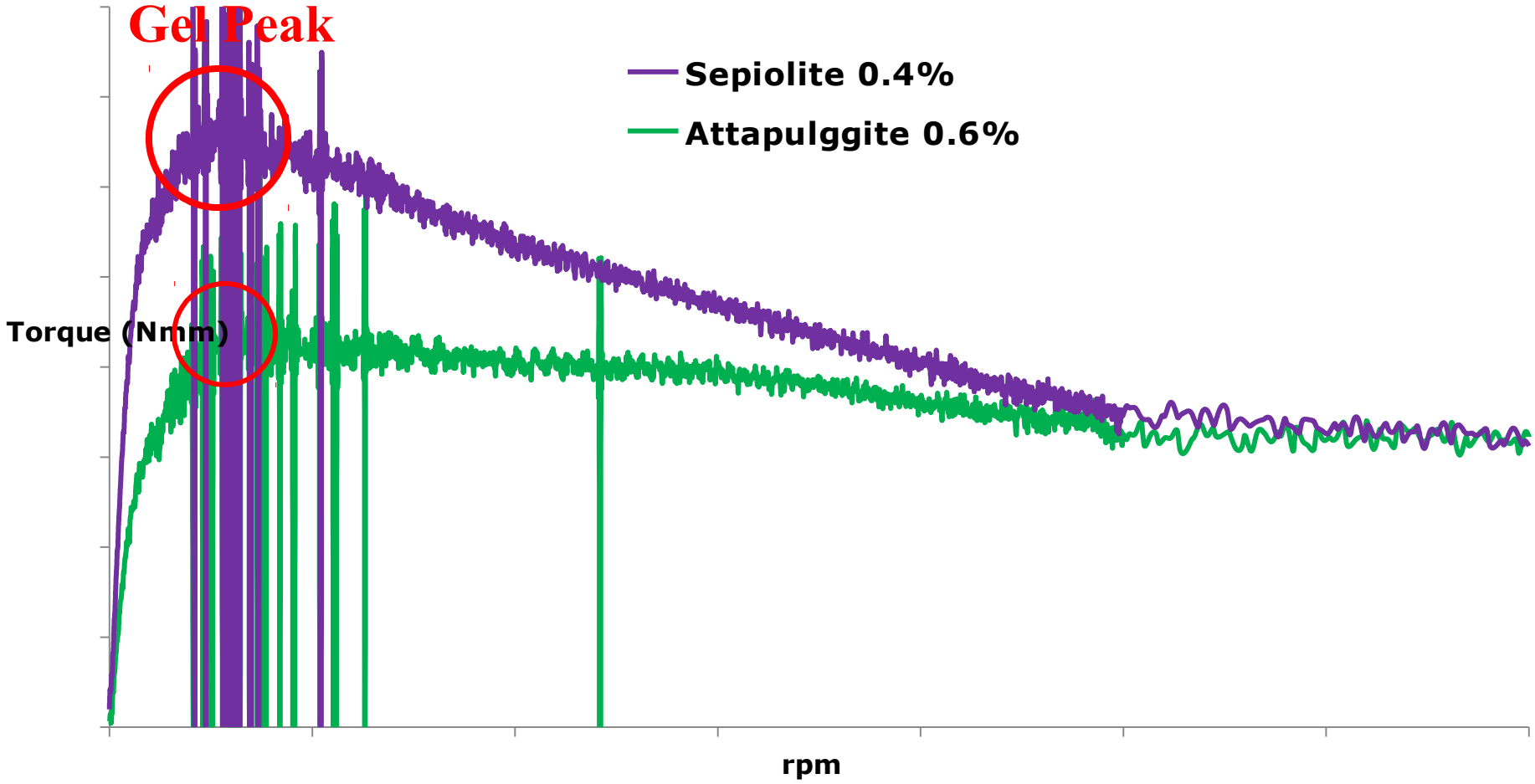
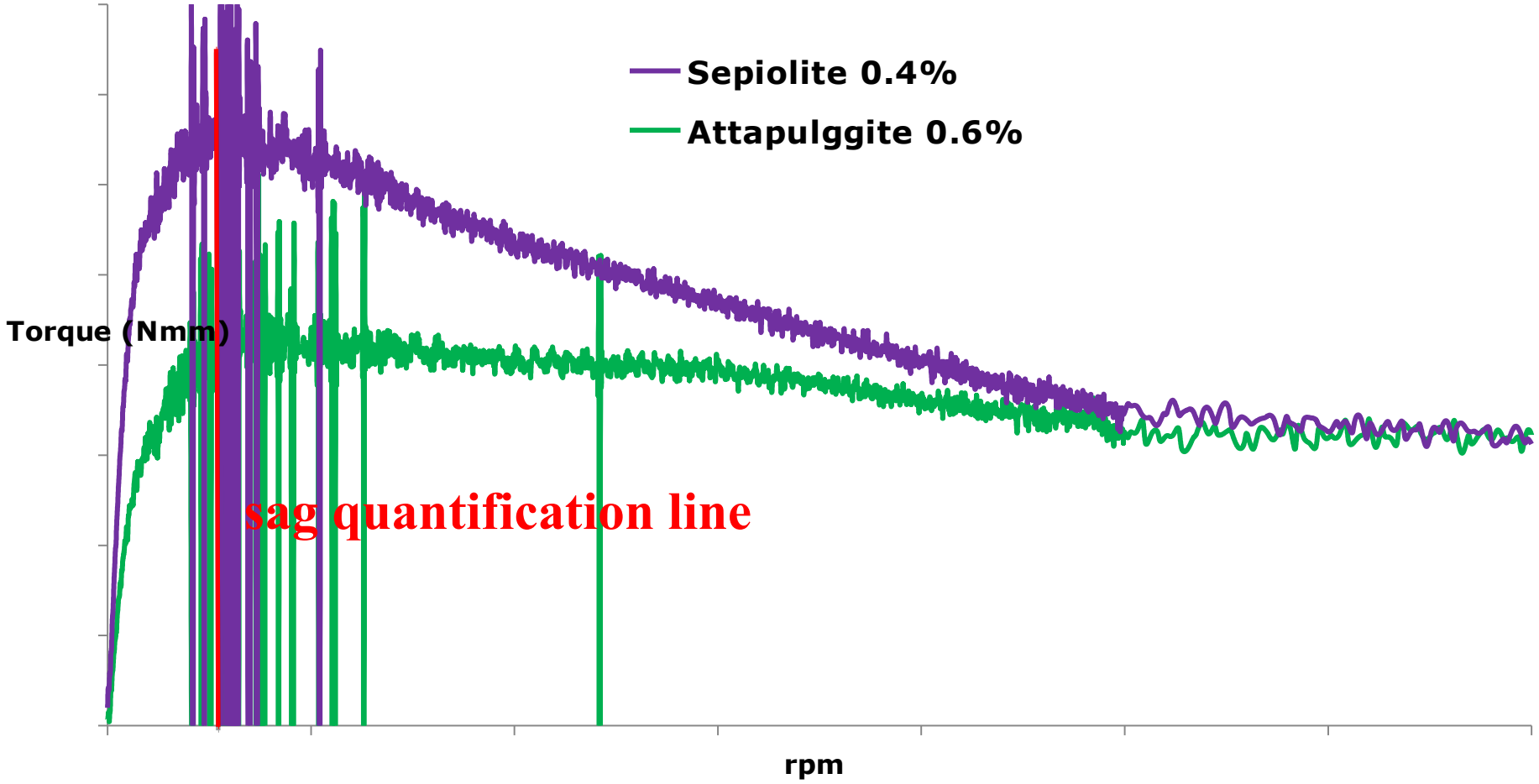
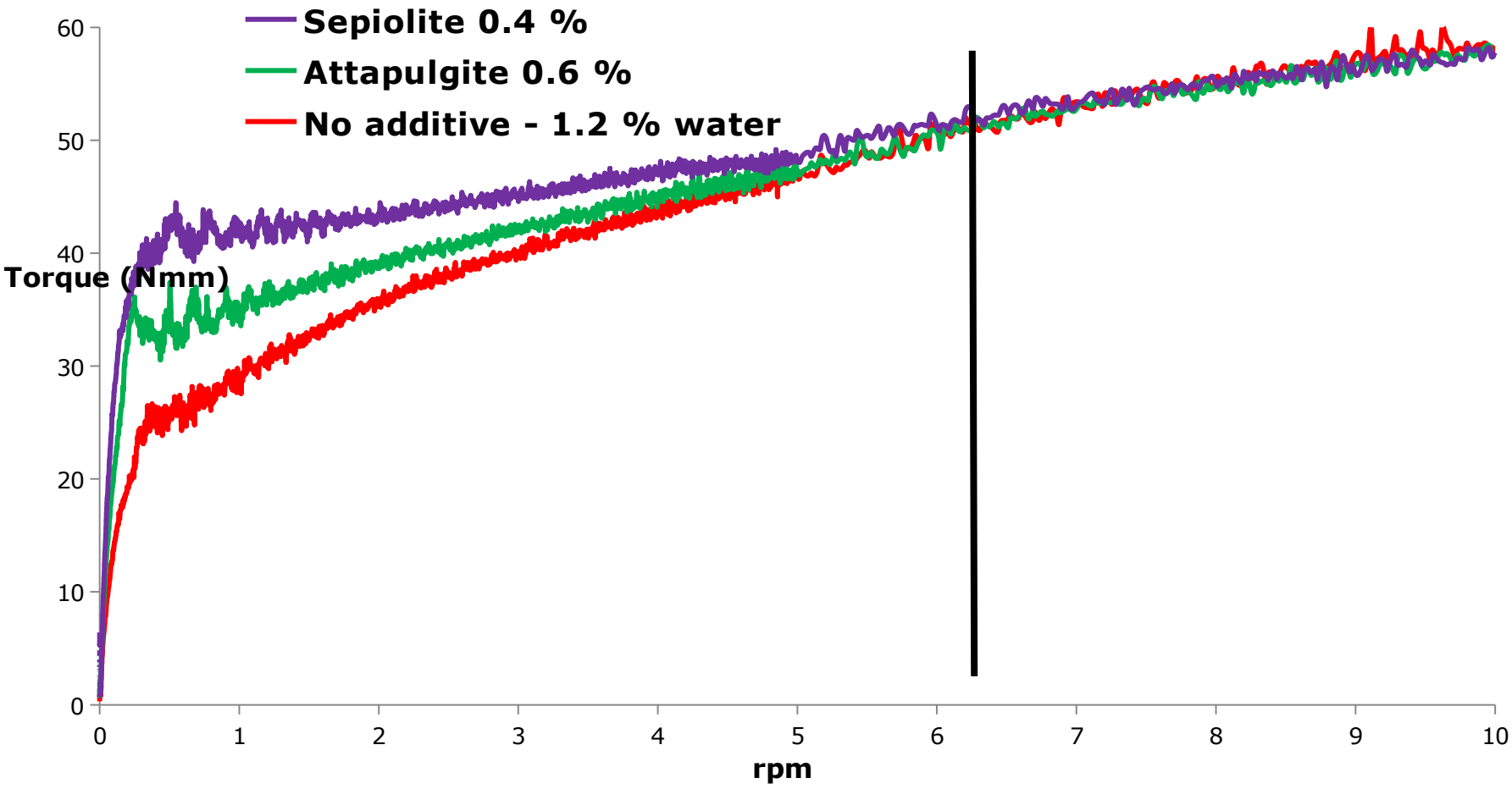


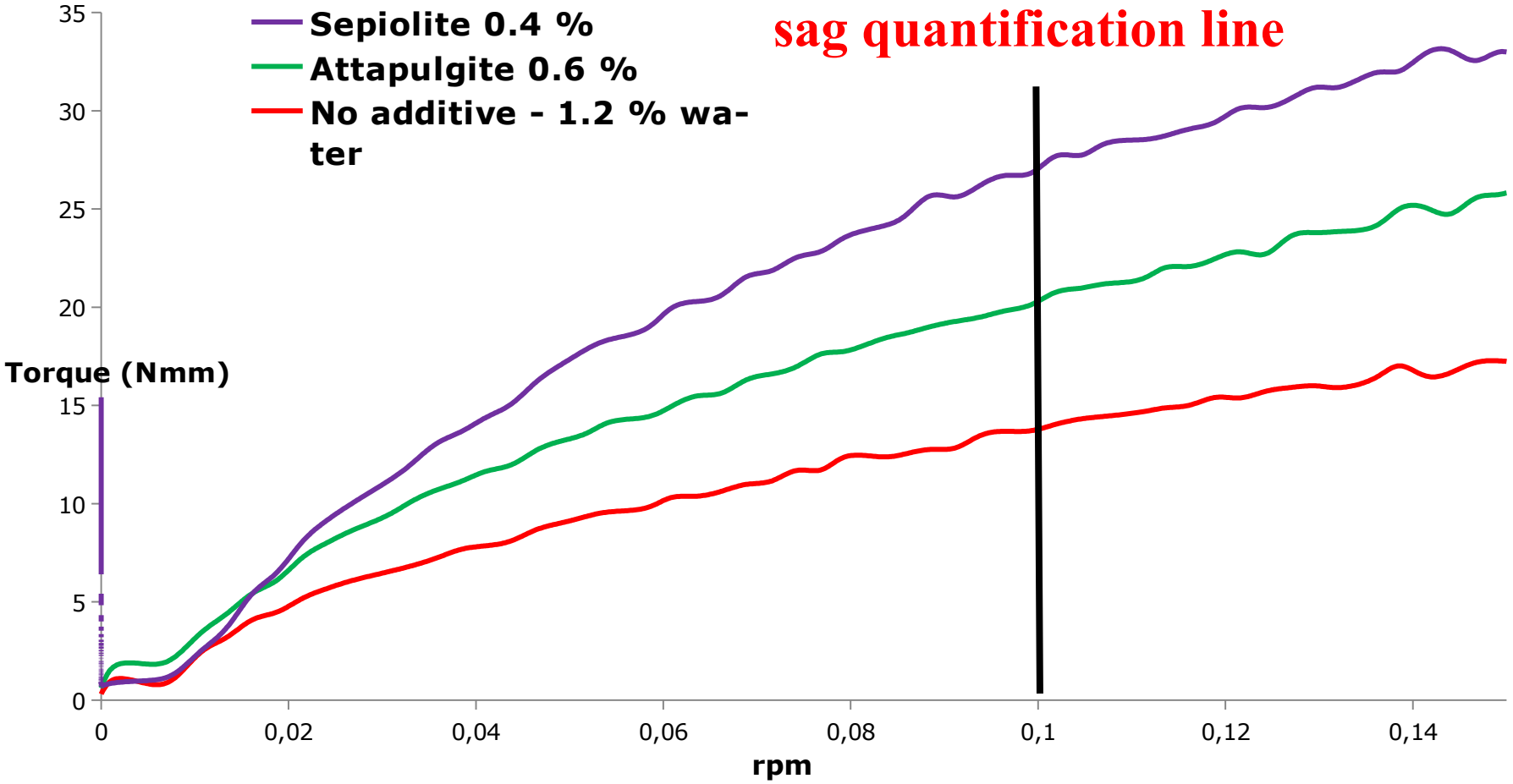
Net additive behaviour



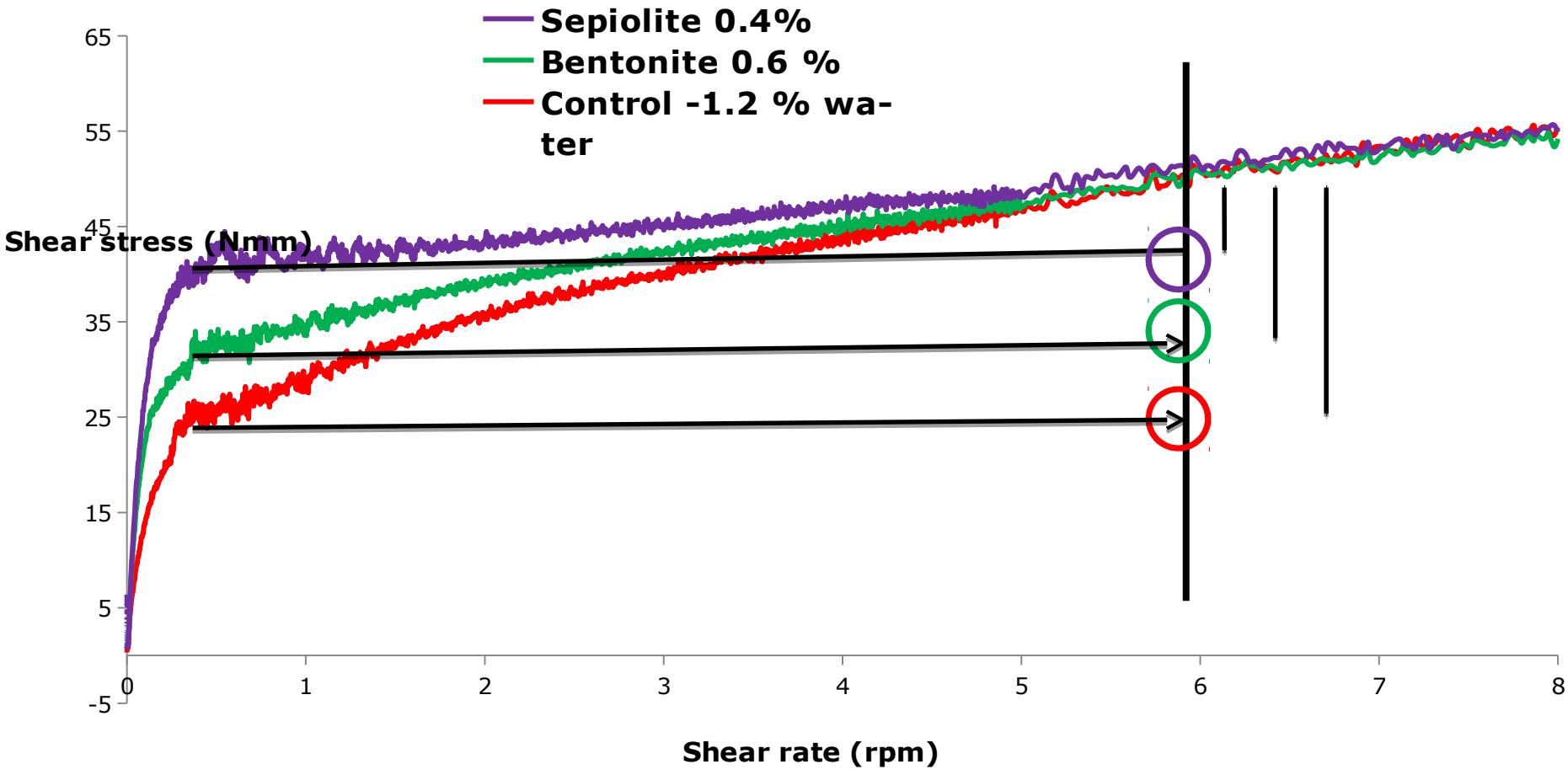
Rheological additives Comparison



Sag /slip quantification



Workability quantification



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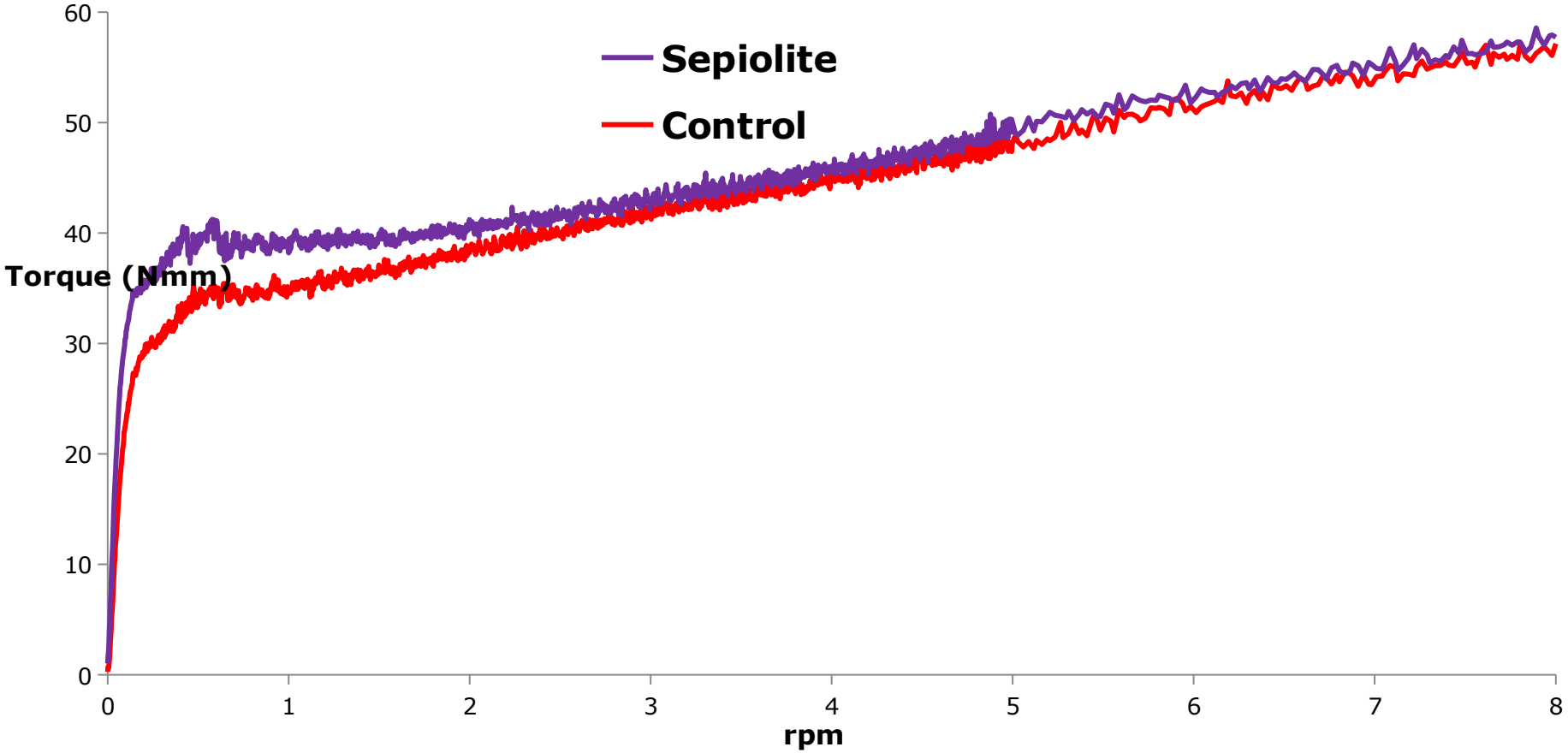
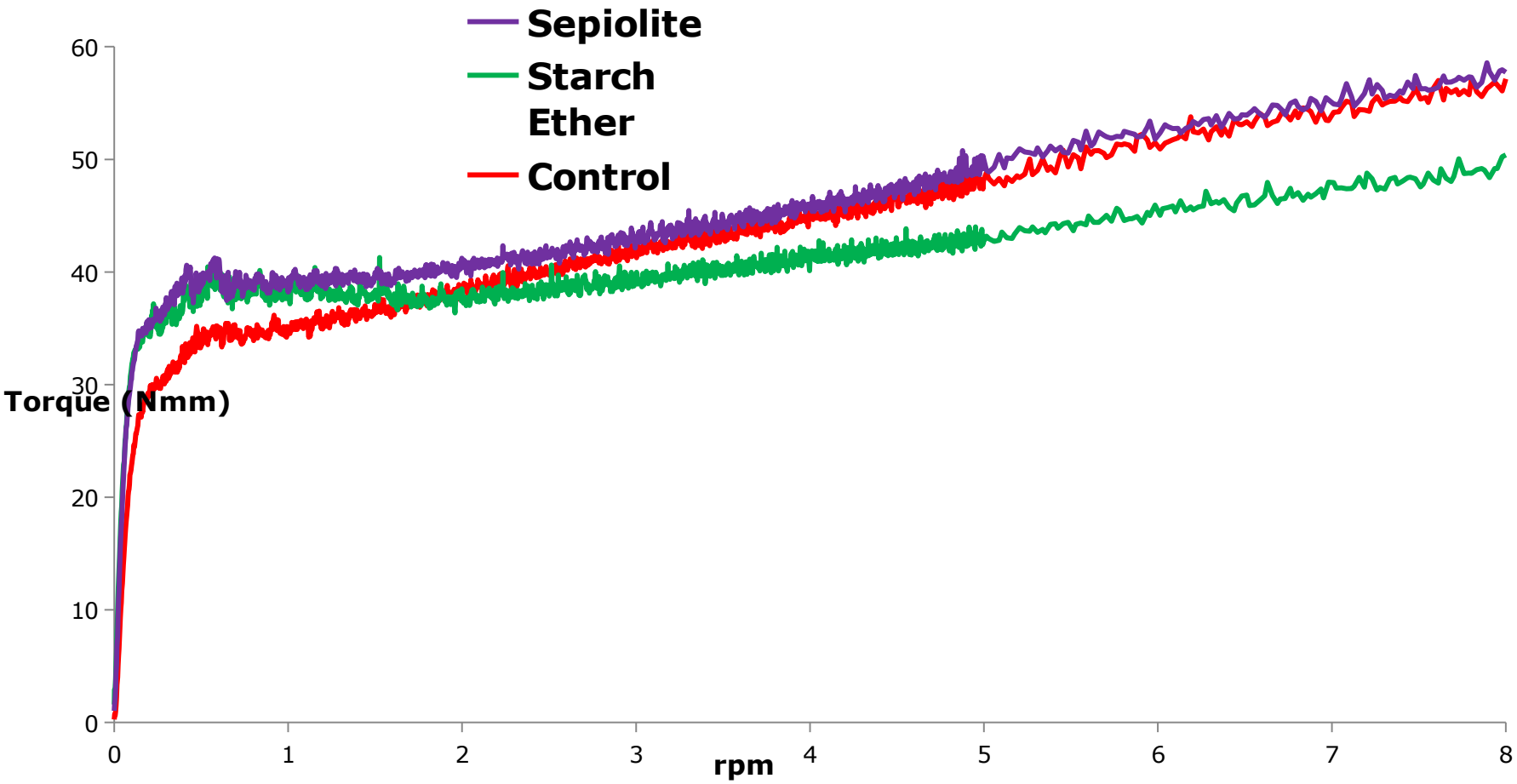
Rheological mineral additives compared with organic thickeners



Rheological mineral additives compared with organic thickeners



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- An empirical method to test workability and slip/ sag resistance is proposed.

- The slip resistance figures has not show the big dispersion of the standard test according to EN-1308.

- Each mineral rheological additive may lead different workability and slip/ sag resistance behavior.

- Mineral rheological additives provide equivalent slip control vs. starch ethers with no effect on mortar properties.

Thanks for your attention

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TOLSA GROUP

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