Gel formation capacity in mortars using mineral rheological additives

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Product Development Additives & Fillers TOLSA

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AGENDA

1- INTRODUCTION

2- FLOW TABLE MEASUREMENTS

3- GEL FORMATION CAPACITY

4- SEDIMENTATION CONTROL CAPACITY

5- ORGANIC THICKENERS

6- RHEOLOGY OF SEPIOLITE vs. BENTONITE

7- CONCLUSIONS

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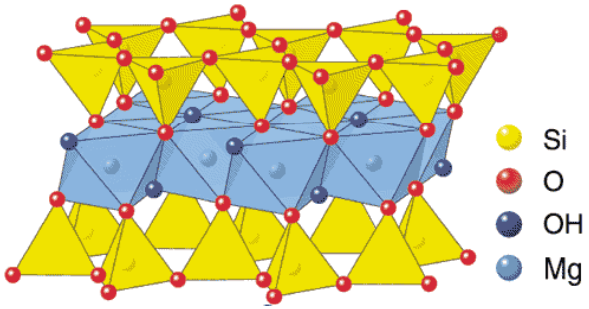
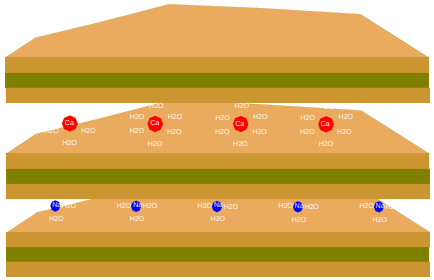
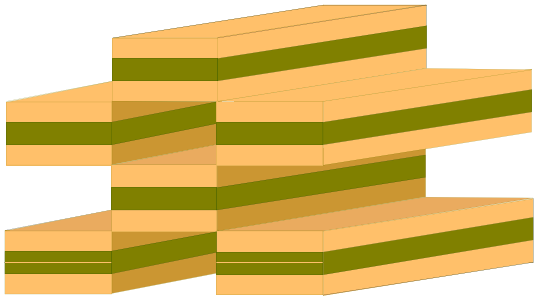
MINERAL RHEOLOGICAL ADDITIVES STRUCTURE

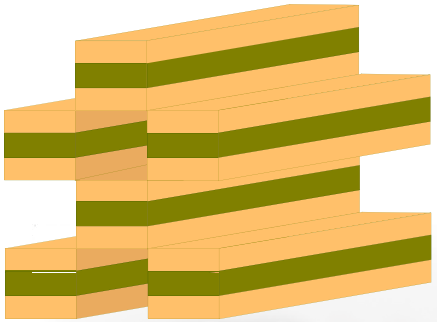




Smectites (Bentonites)

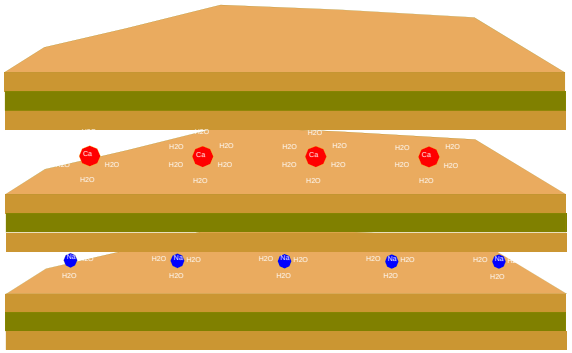


Sepiolite

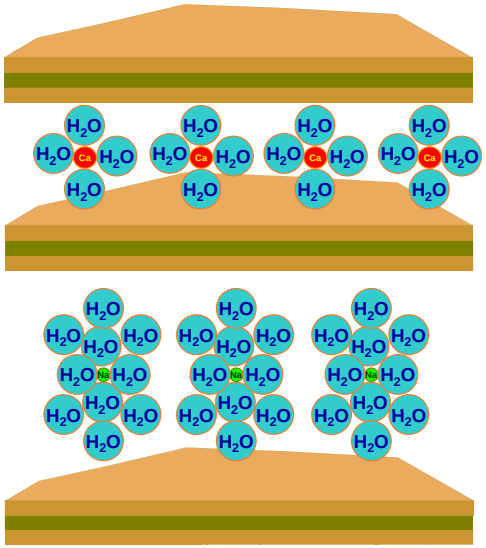


Attapulgite

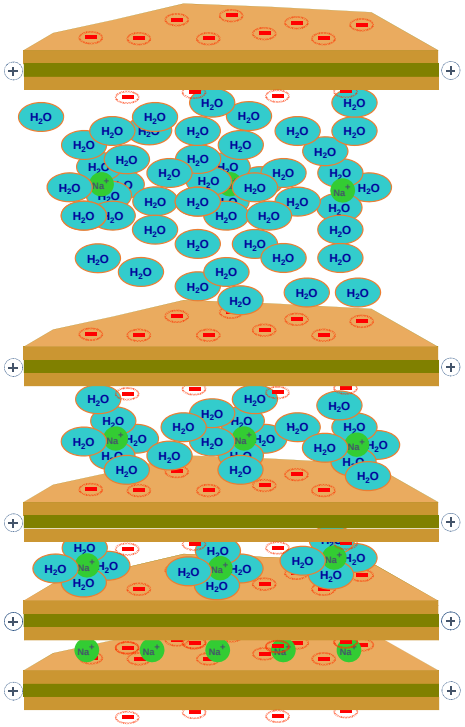
BENTONITE SWELLING

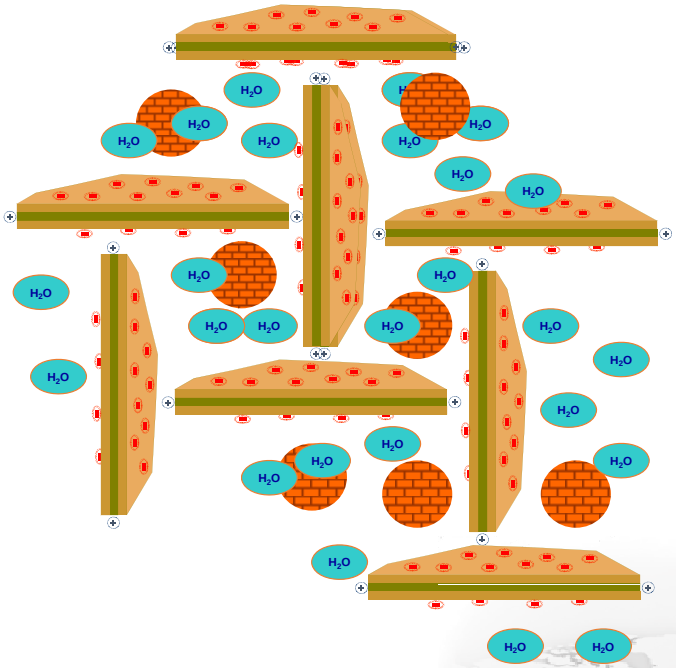


Swelling in presence of water

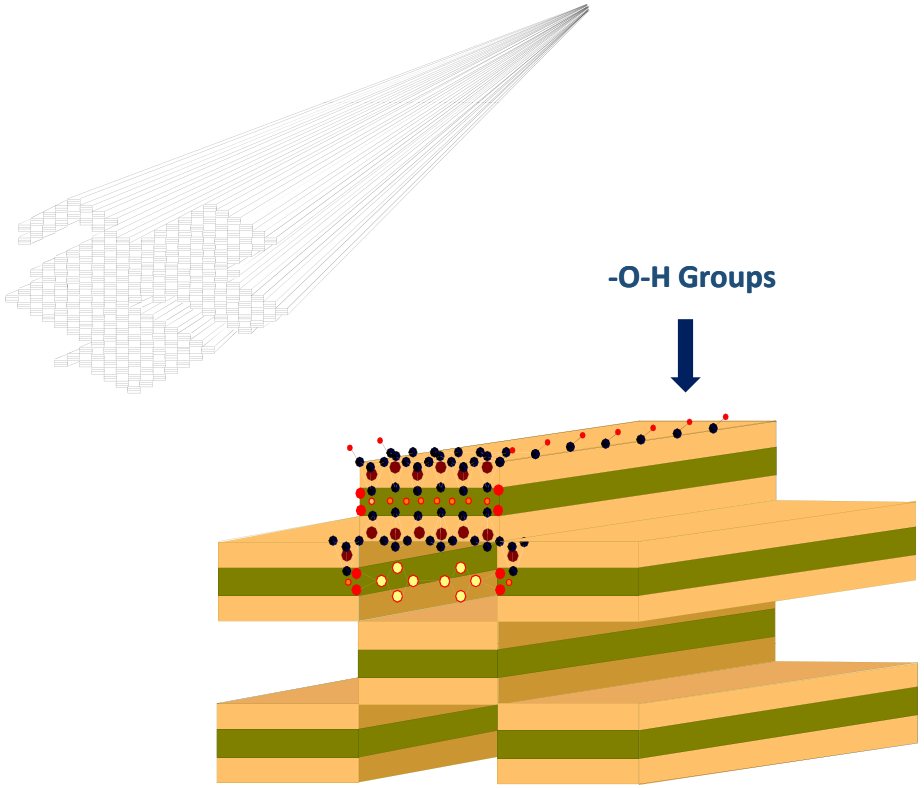


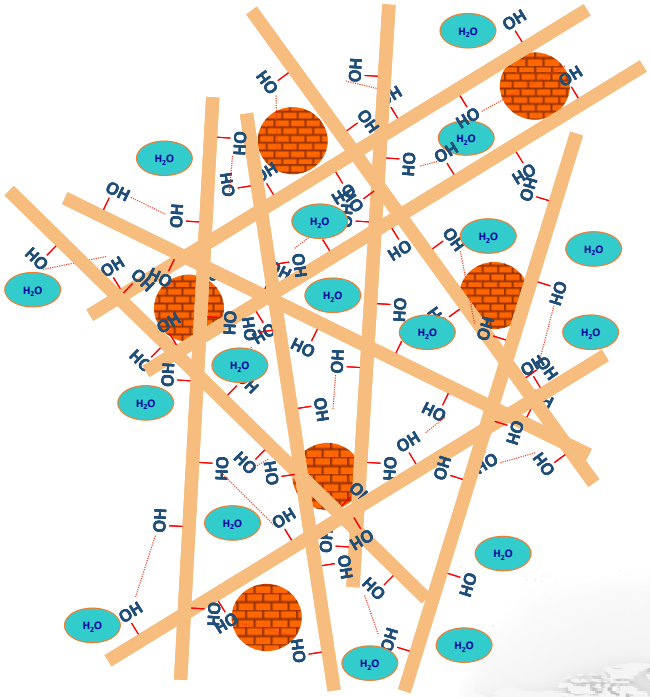
BENTONITE GELLING MECHANINSM



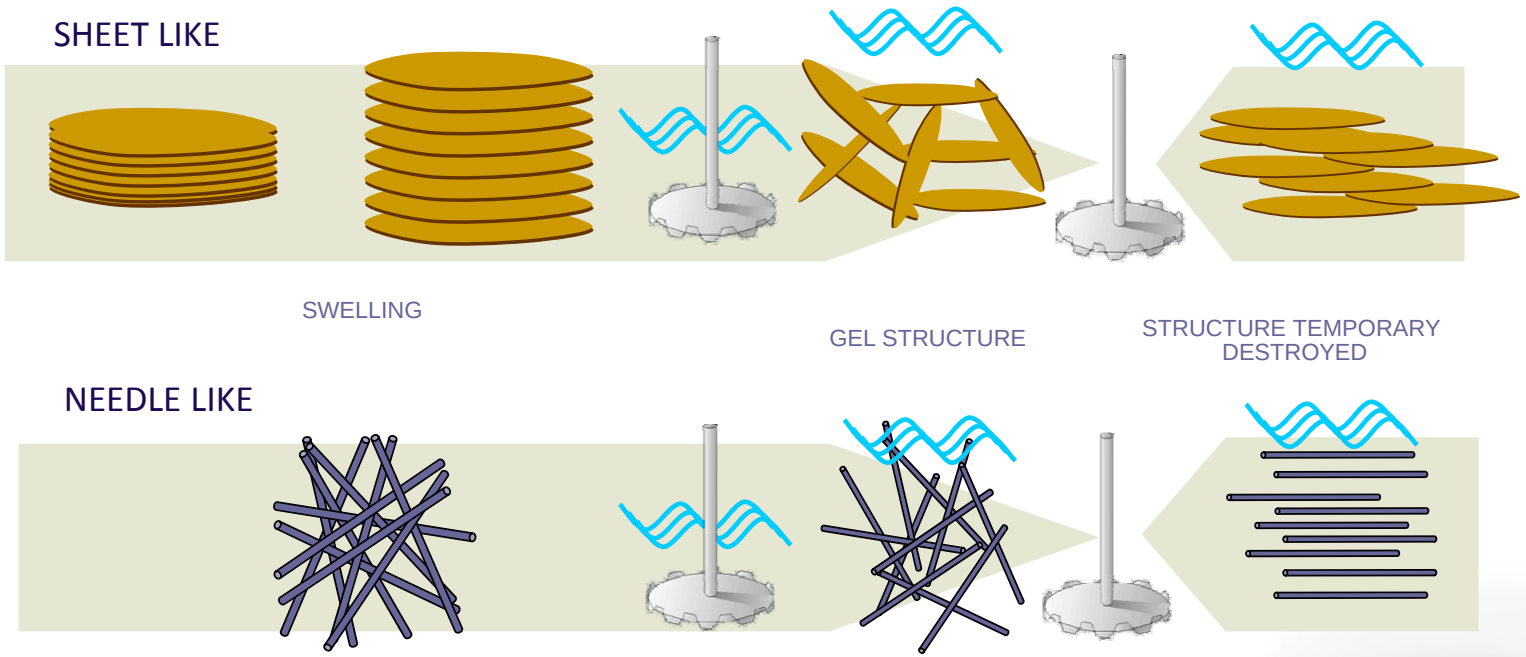


SEPIOLITE GELLING MECHANINSM

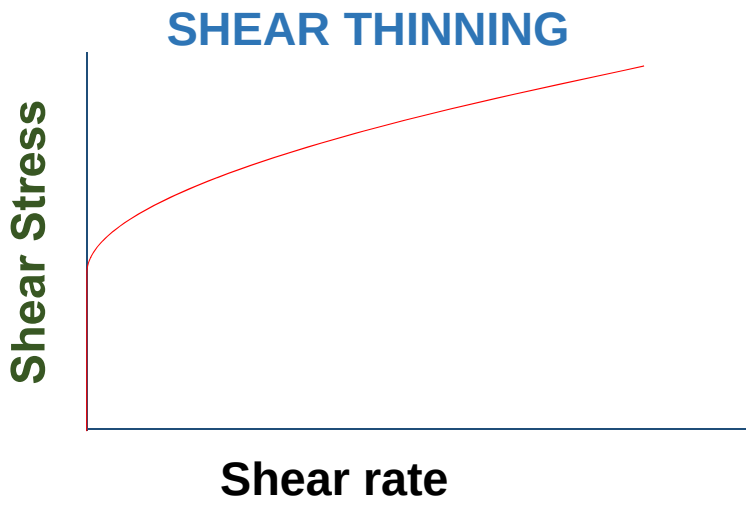


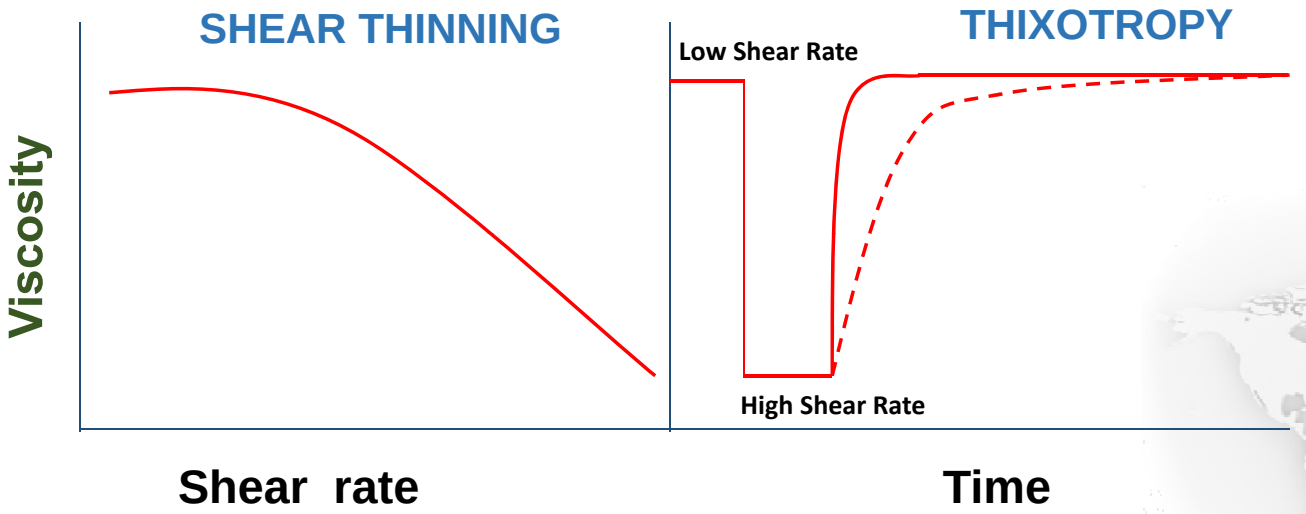


CLAYS GELLING MECHANINSM



RHEOLOGICAL CURVES





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2- FLOW TABLE MEASUREMENTS

3- GEL FORMATION CAPACITY

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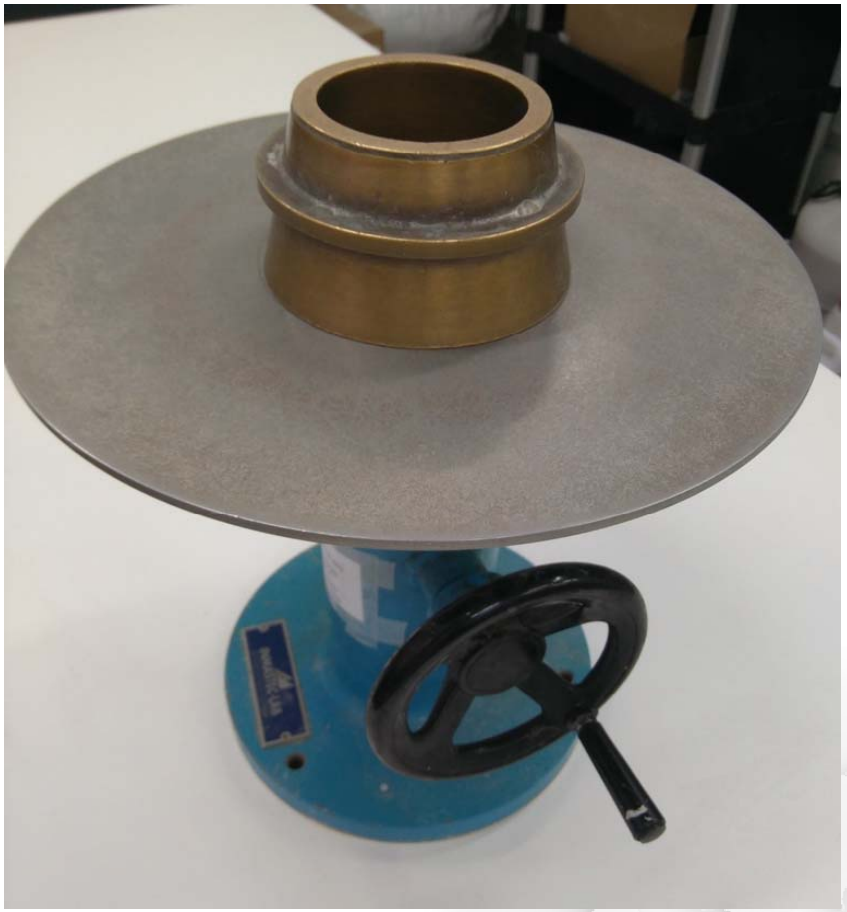
FLOW TABLE MEASUREMENTS



FLOW TABLE: VISKOMAT NT

- **Rotational in Control rate mode (CR):**

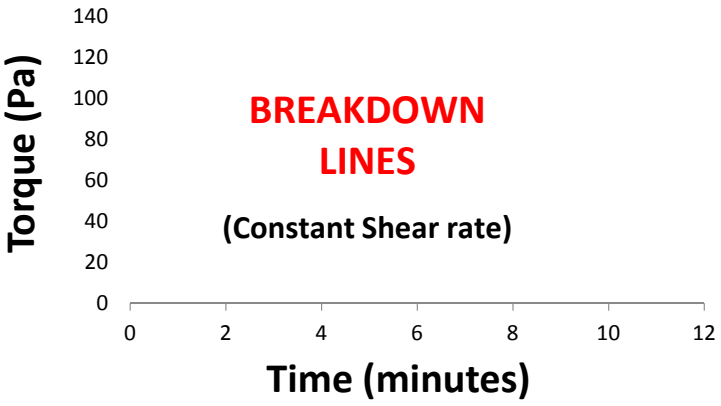
The shear rate (rpm) is set and the shear stress is measure.

- **Three type of tests:**

- Constant shear rate or rpm
- Reducing shear rate
- Increasing shear rate

FLOW TABLE: VISKOMAT NT PROFILES

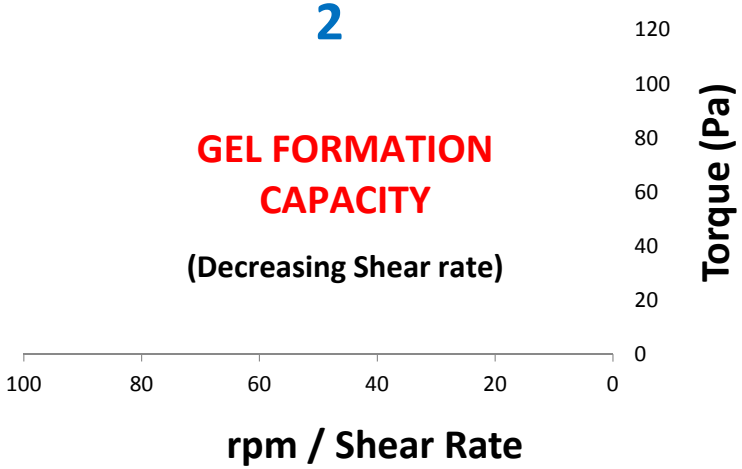
1



BREAKDOWN LINES

(Constant Shear rate)

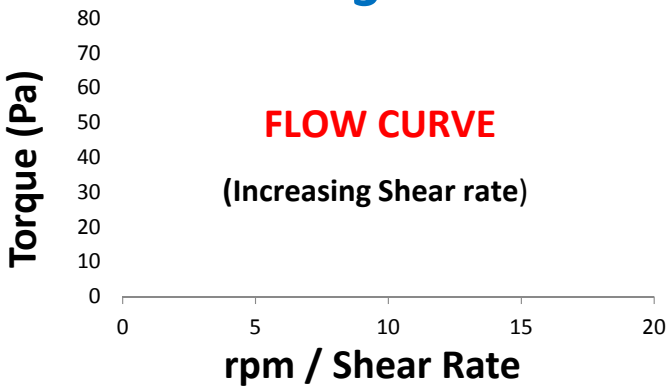
2



GEL FORMATION CAPACITY

(Decreasing Shear rate)

3



FLOW CURVE

(Increasing Shear rate)

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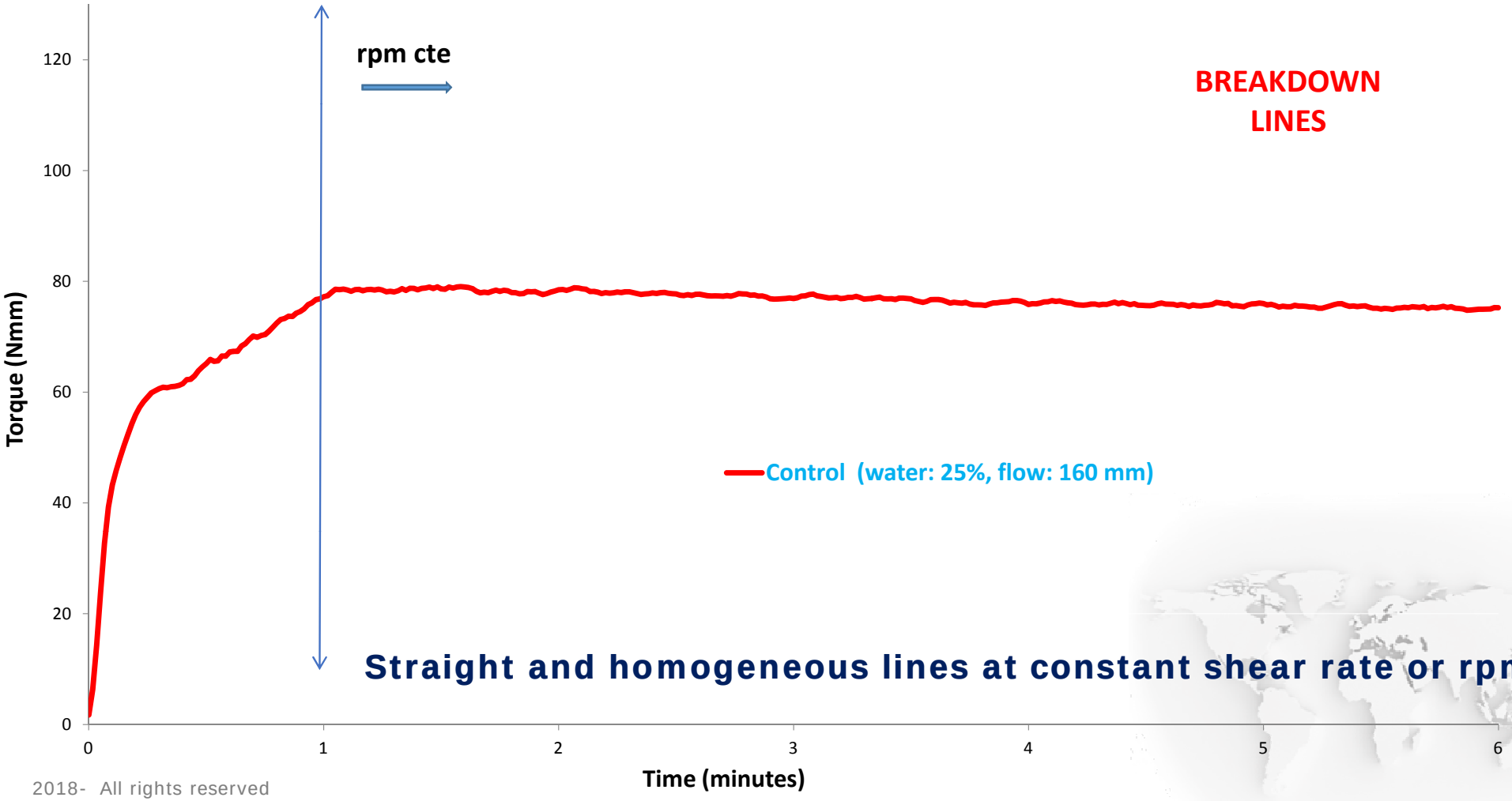
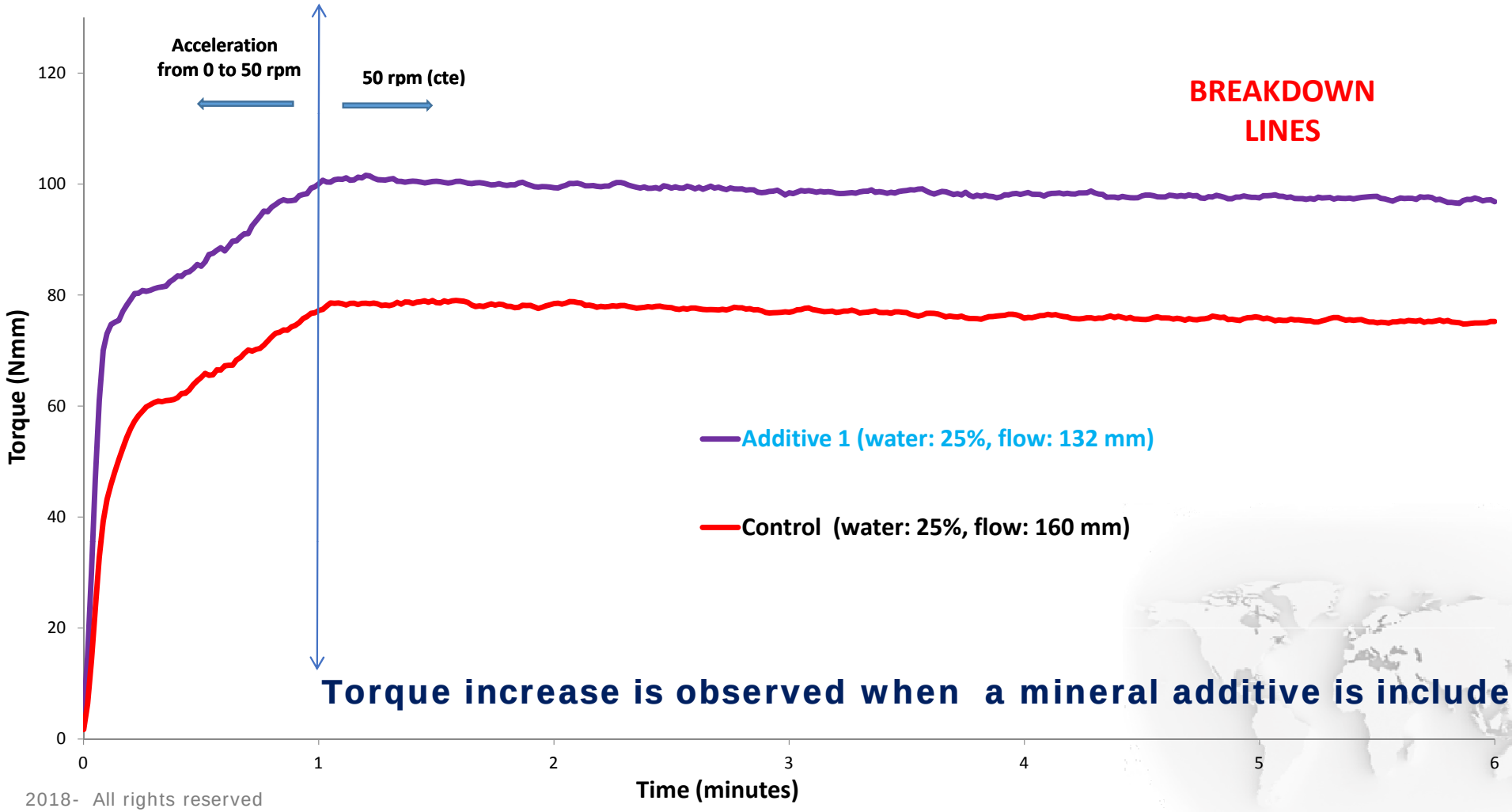
FLOW TABLE MEASUREMENTS: Constant Rate

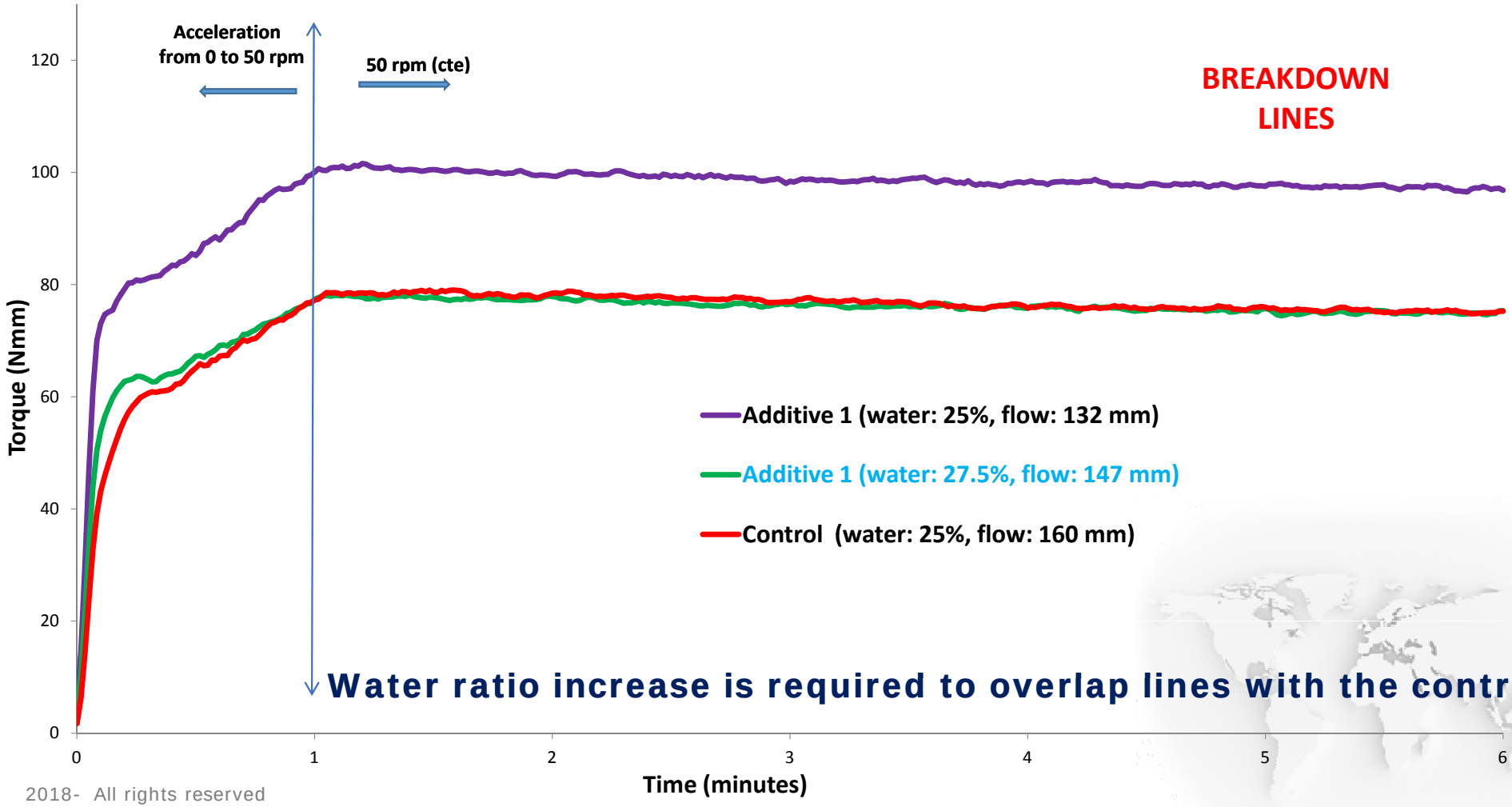


FLOW TABLE MEASUREMENTS



Torque increase is observed when a mineral additive is included

FLOW TABLE MEASUREMENTS



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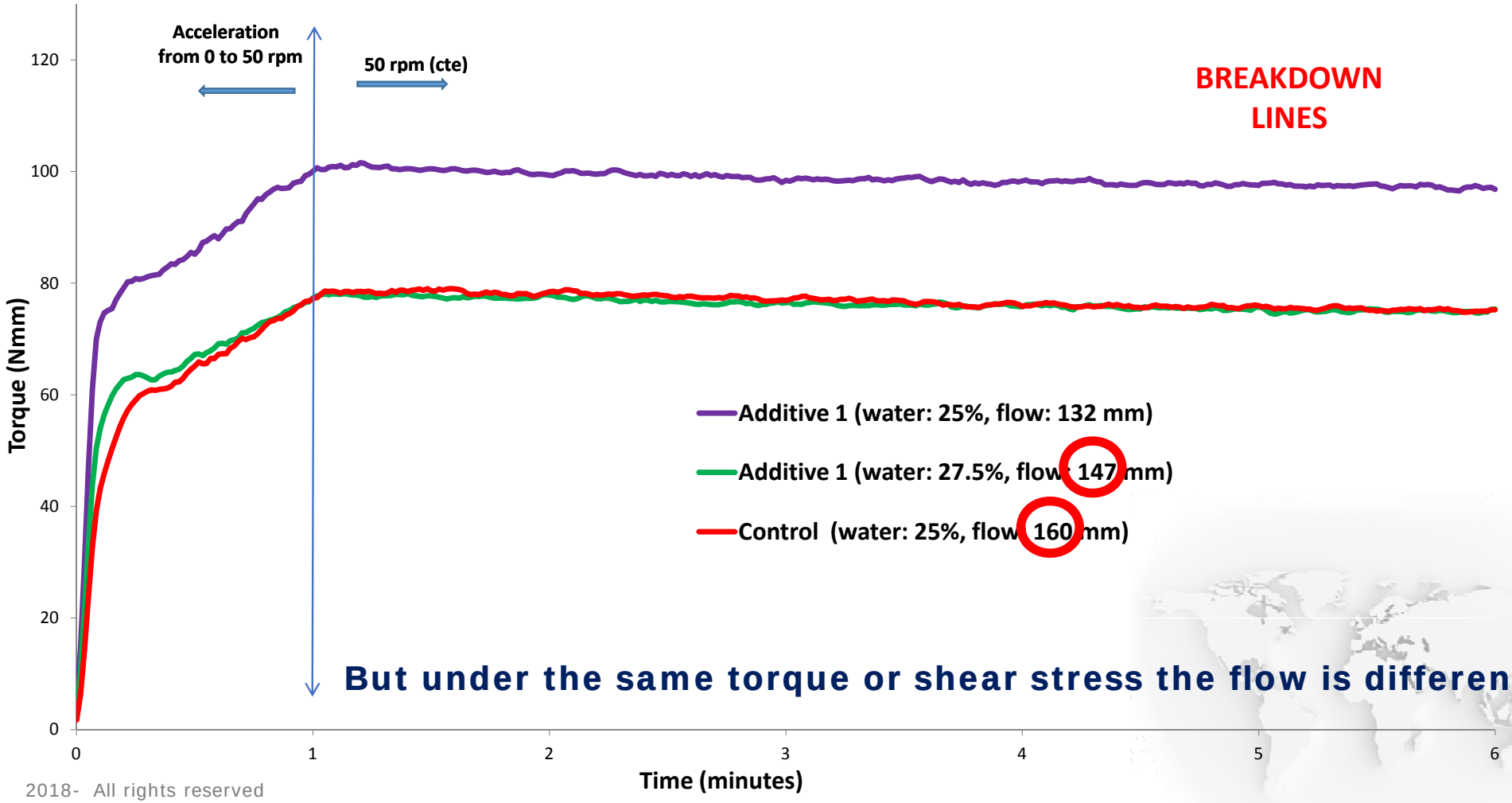

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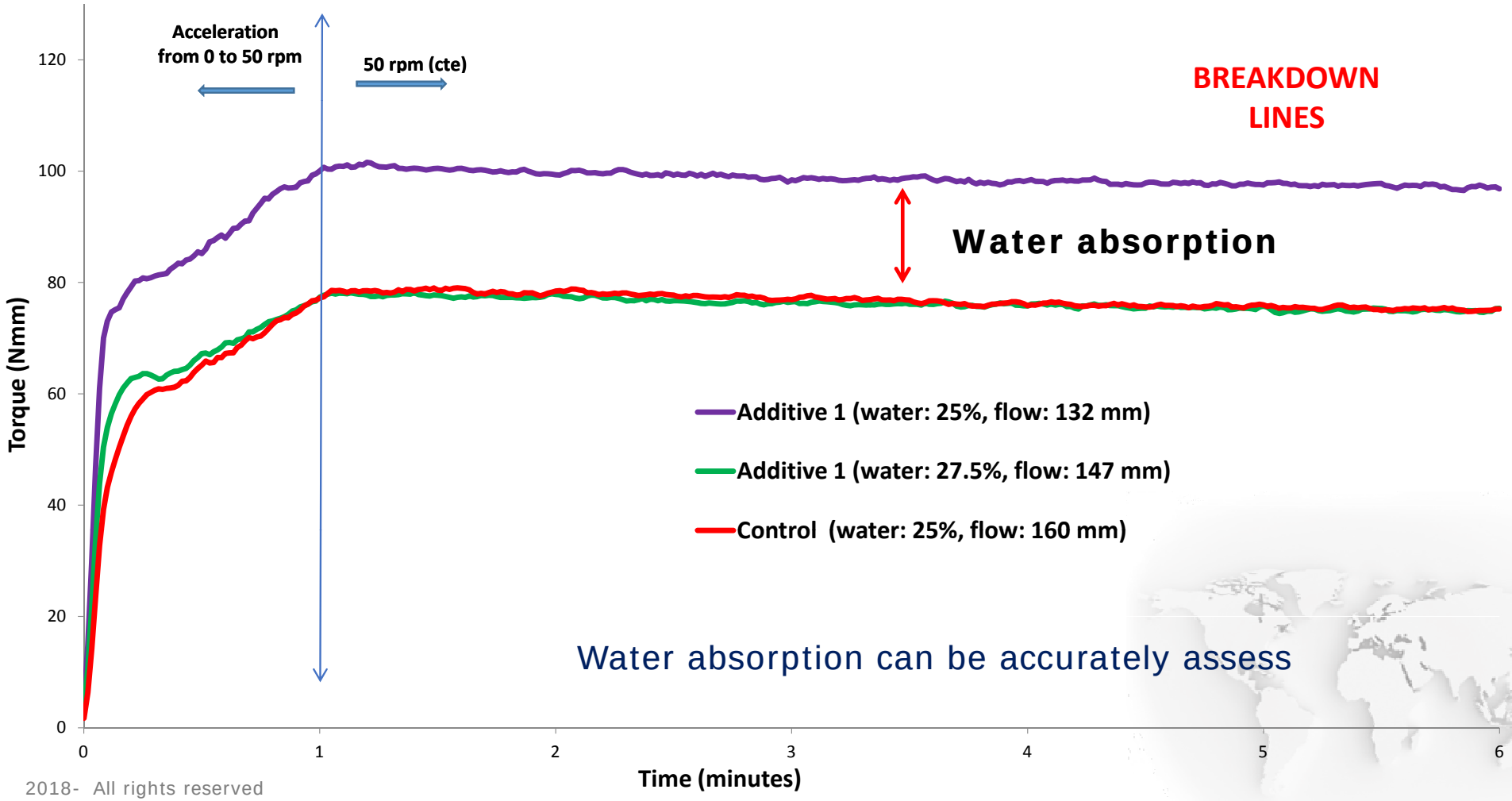

Water absorption can be accurately assess

FLOW TABLE MEASUREMENTS

- Flow table test could not be the most accurate method to verify water demand under shear stress, strokes applied during the flow table test are actually not strong enough to break the three dimensional network formed.

- Rheometers could also be an interesting way of testing the water absorption of additives under a specific shear stress.

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GEL FORMATION CAPACITY

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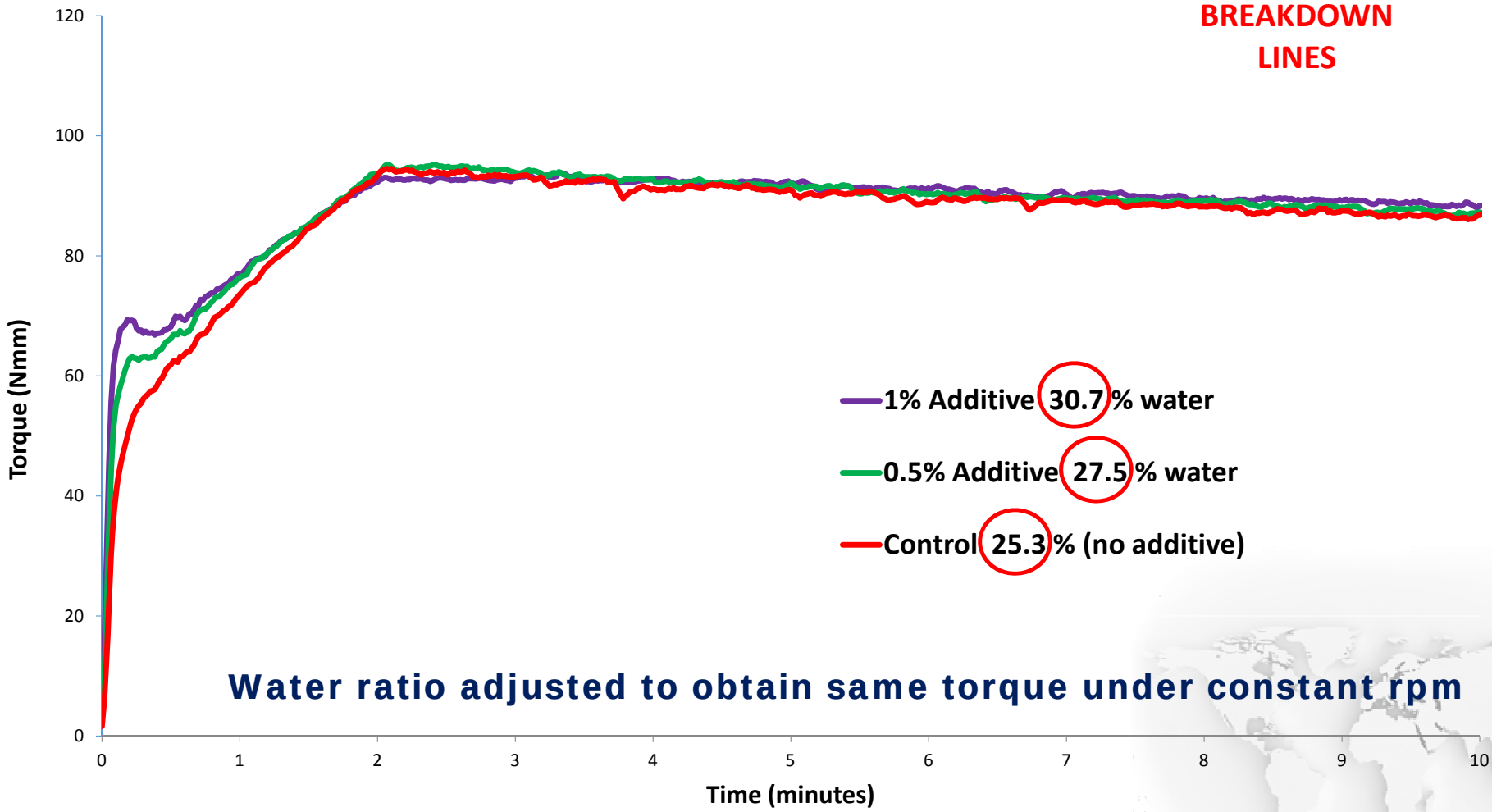

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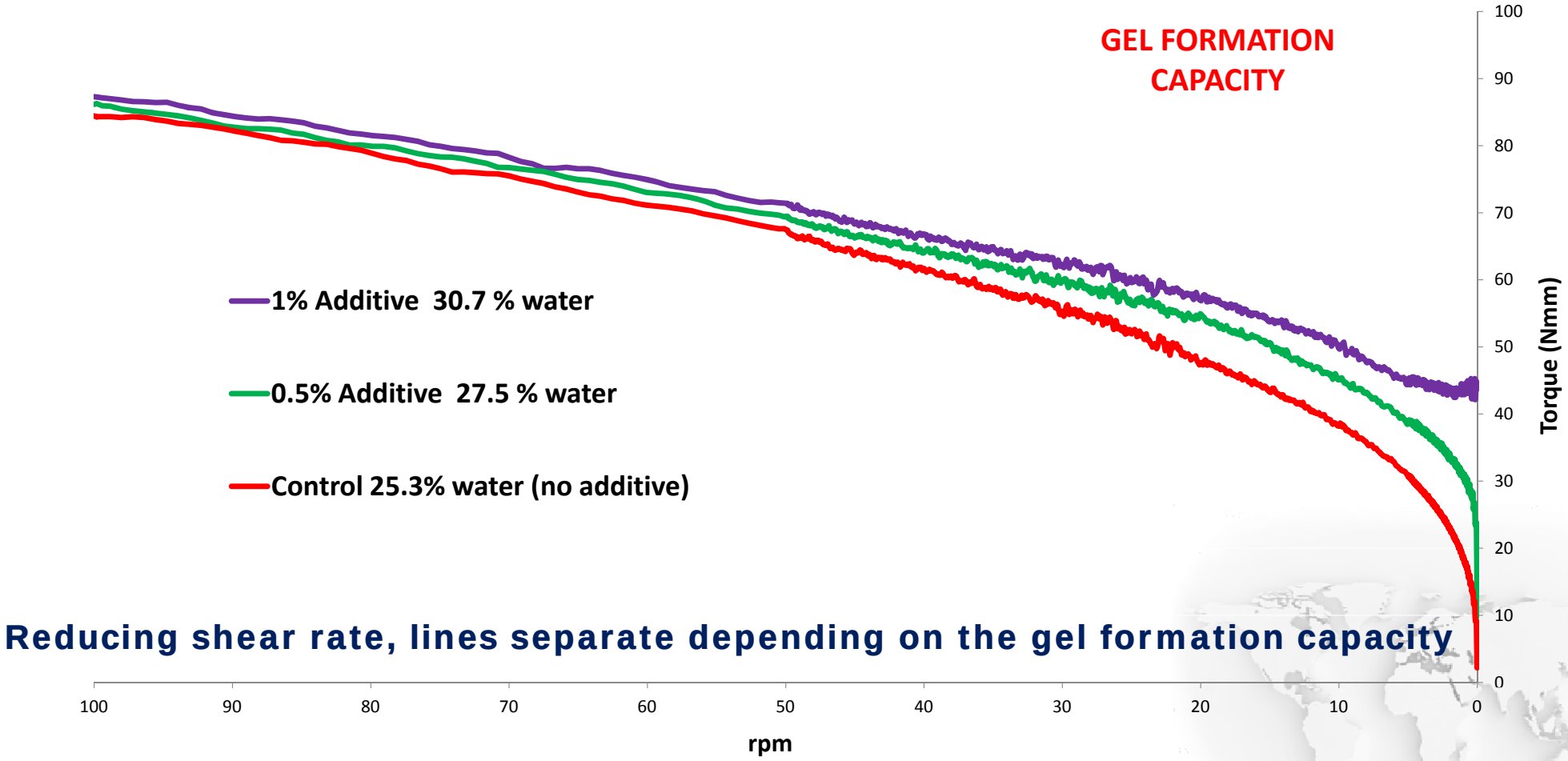
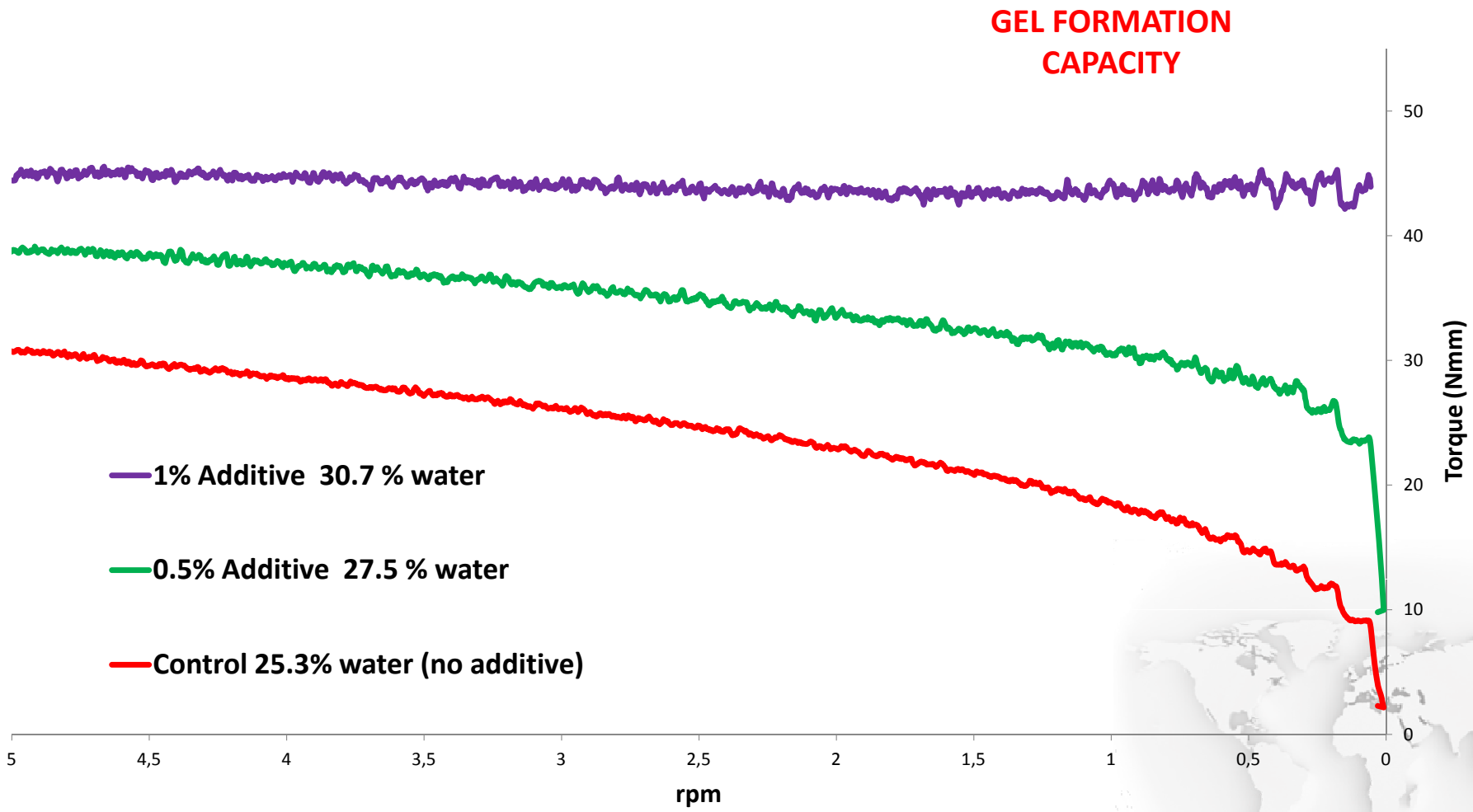
GEL FORMATION CAPACITY

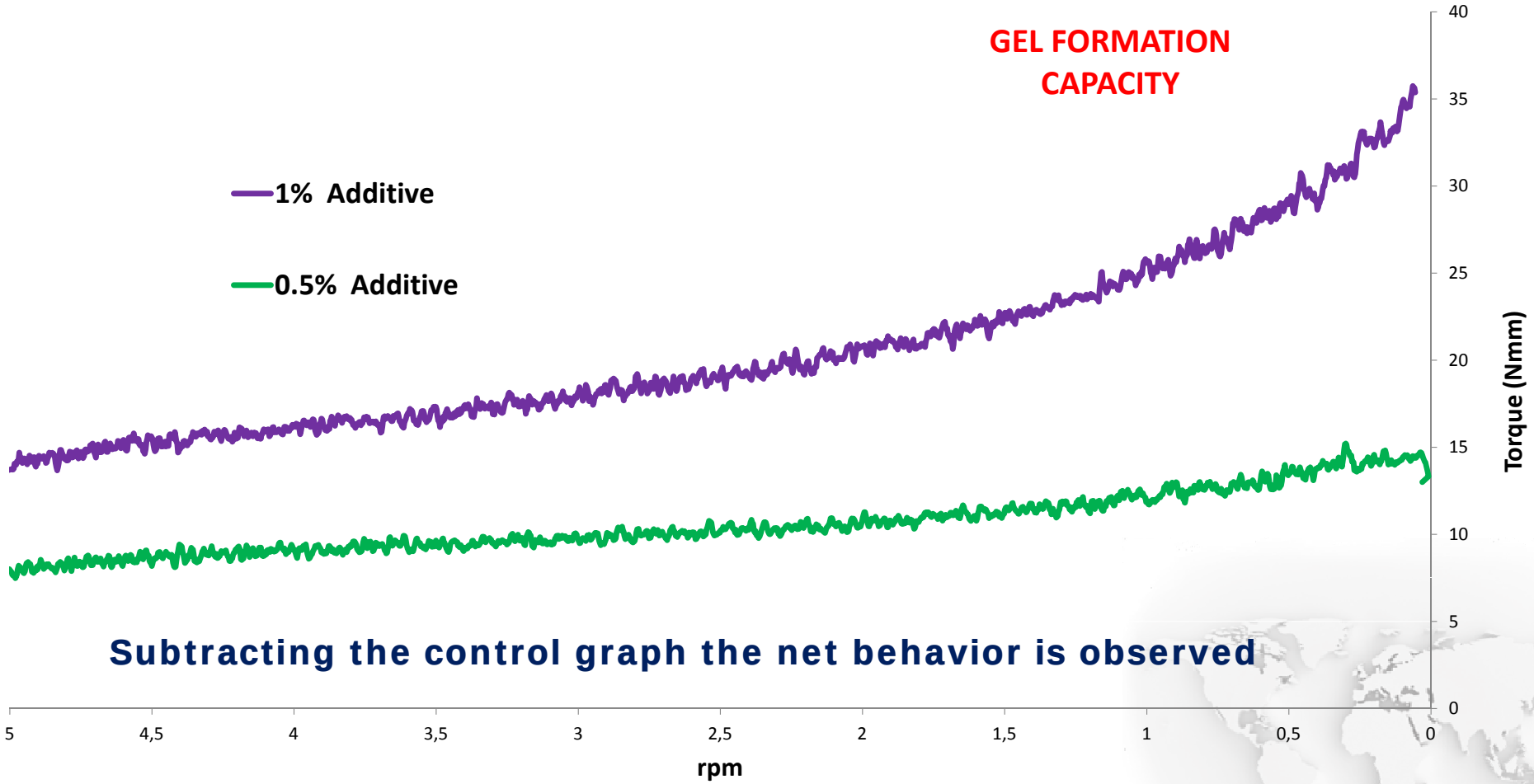


Reducing shear rate, lines separate depending on the gel formation capacity

GEL FORMATION CAPACITY



GEL FORMATION CAPACITY: NET BEHAVIOR



GEL FORMATION CAPACITY or DYNAMIC CONDITIONS

- Net gel formation capacity of mineral thickeners when the shear rate is decreasing could be quantify

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SEDIMENTATION CONTROL: FLOW CURVE

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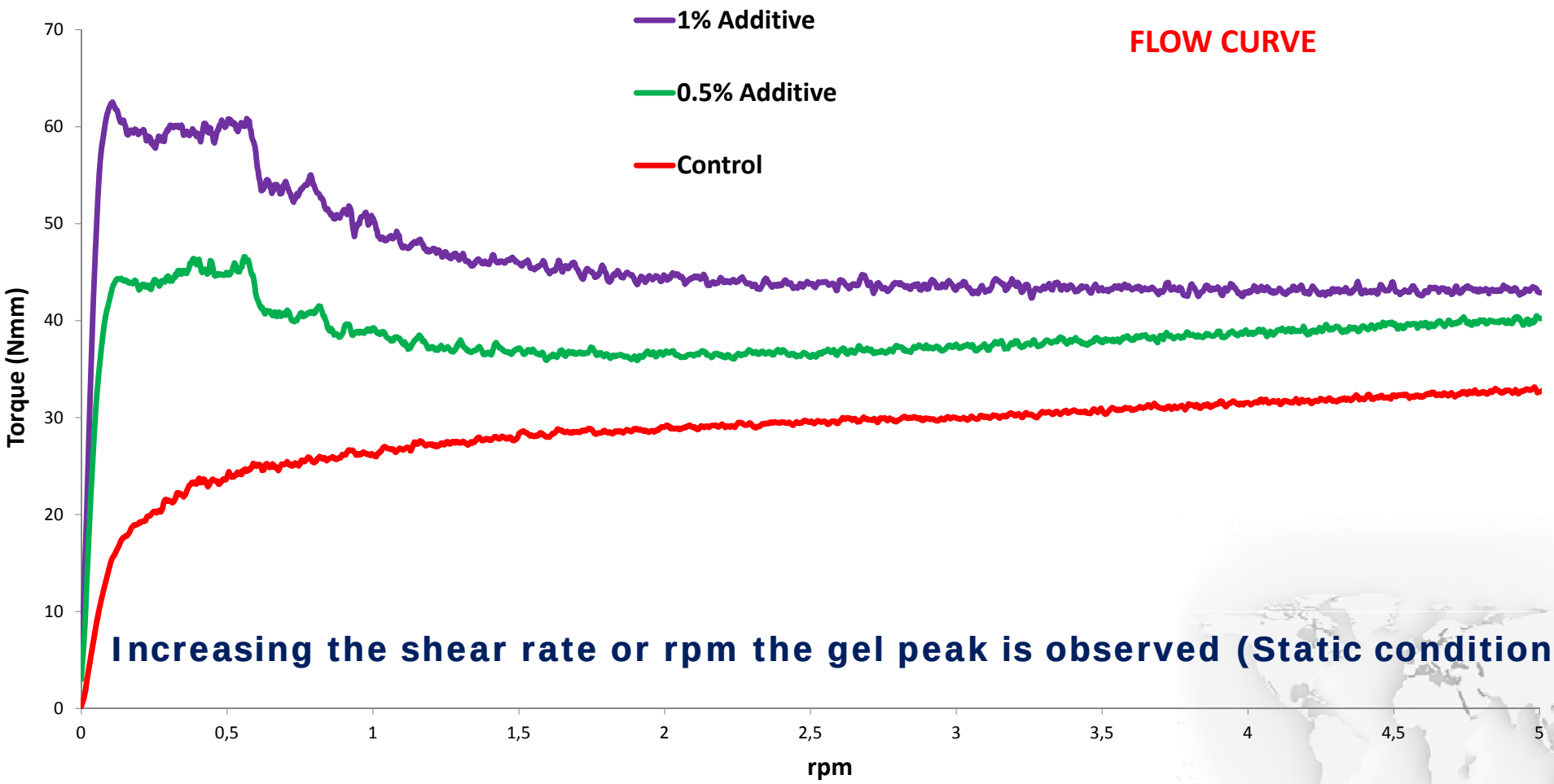
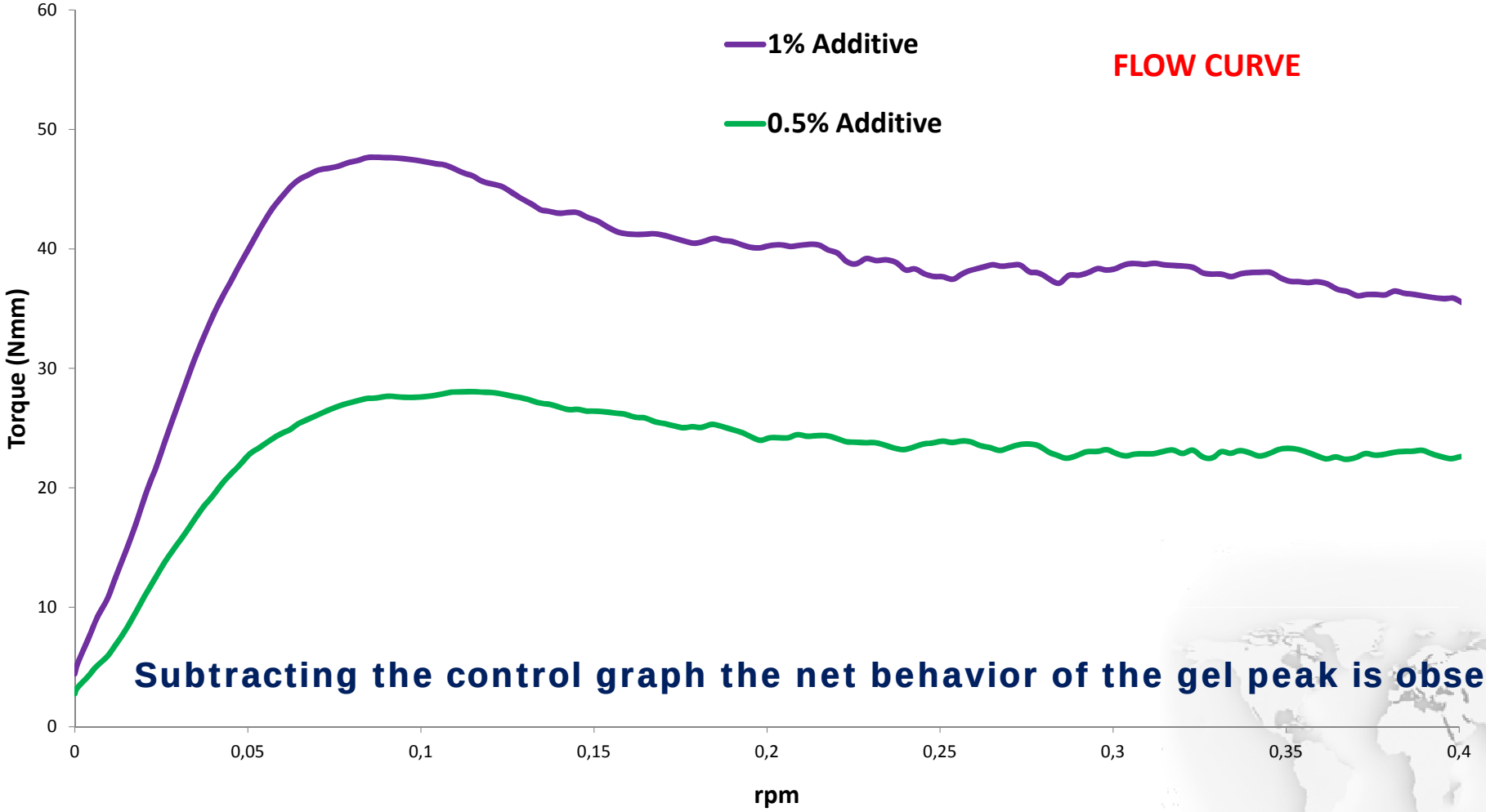


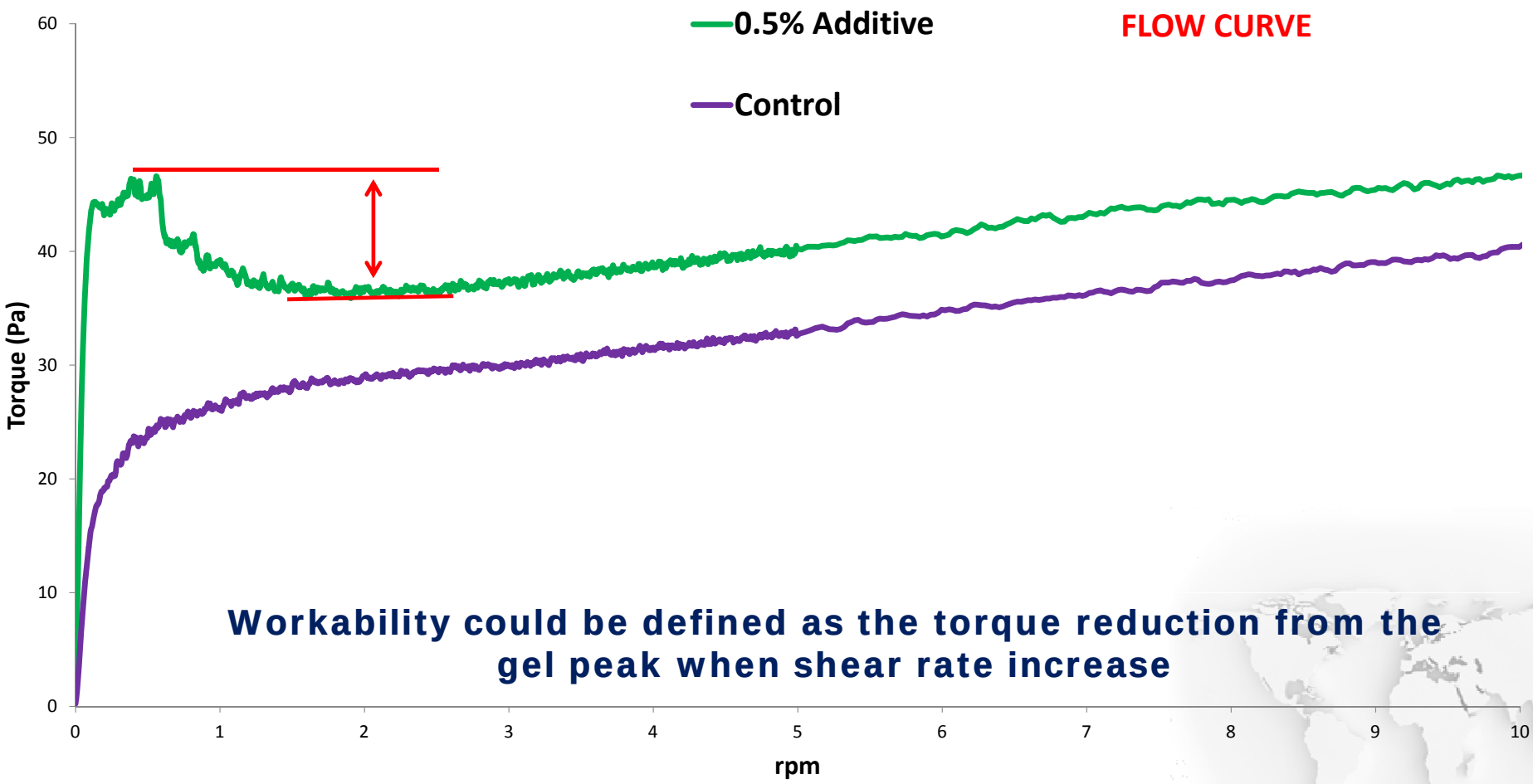
Increasing the shear rate or rpm the gel peak is observed (Static conditions)

SEDIMENTATION CONTROL: NET BEHAVIOR



Subtracting the control graph the net behavior of the gel peak is observed

SEDIMENTATION CONTROL: WORKABILITY



Workability could be defined as the torque reduction from the gel peak when shear rate increase

SEDIMENTATION CONTROL or STATIC CONDITIONS

- In the shear rate increase test, the gel peak gives information about sag/slip control and sedimentation resistance. Workability in this test could also be quantified.

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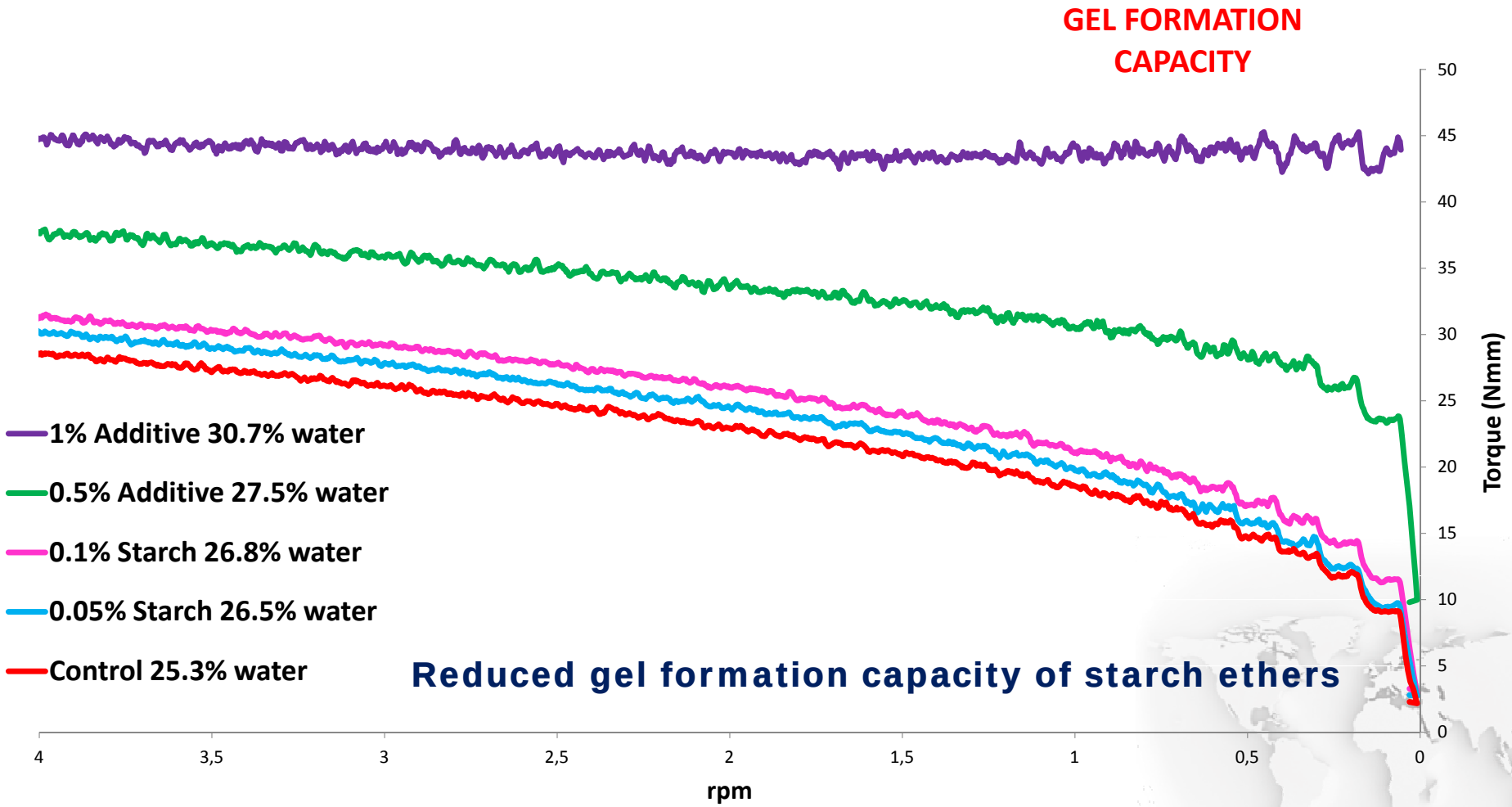
4- SEDIMENTATION CONTROL CAPACITY

5- ORGANIC THICKENERS

6- RHEOLOGY OF SEPIOLITE vs. BENTONITE

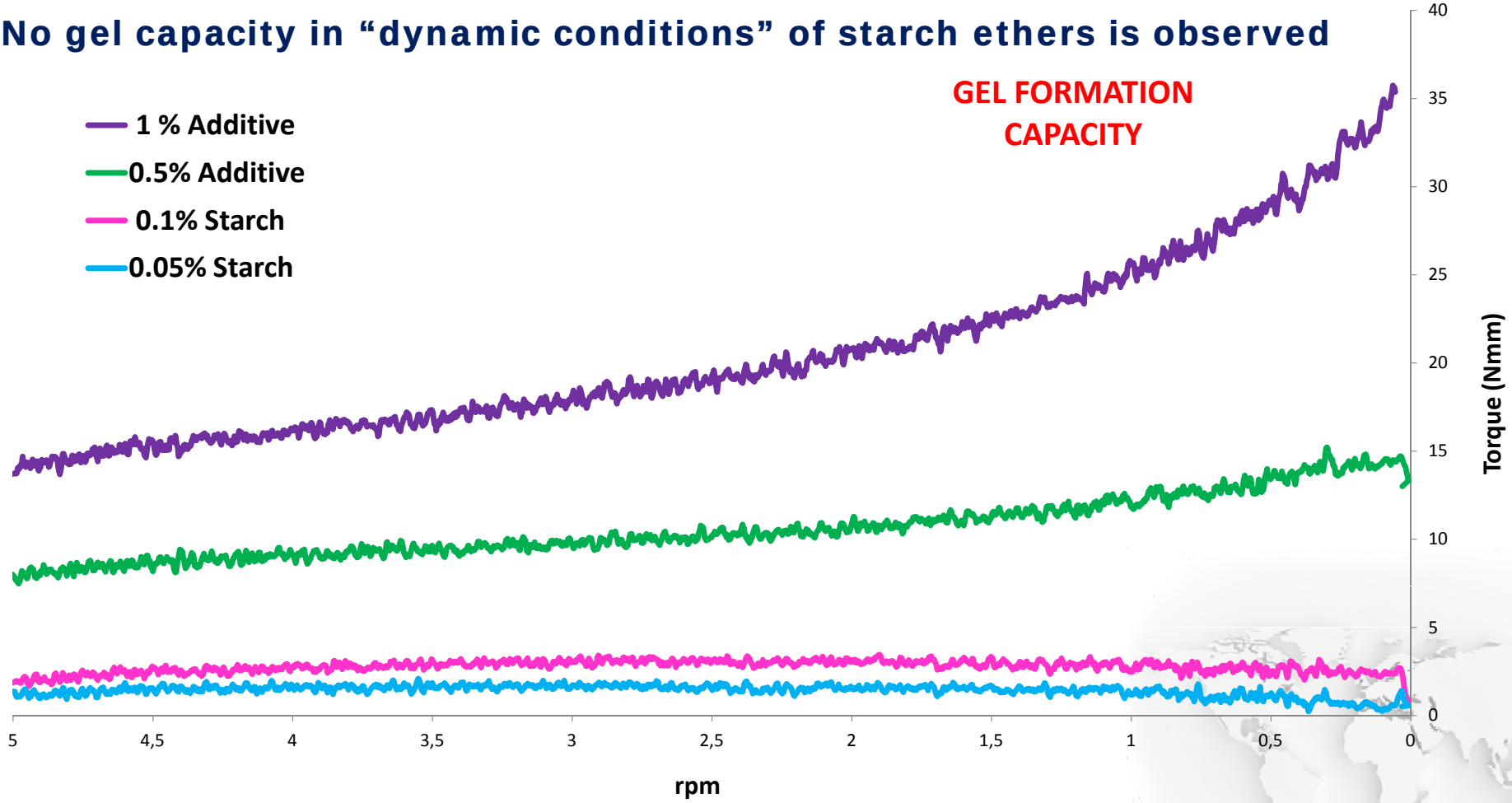
7- CONCLUSIONS

ORGANIC THICKENERS: GEL FORMATION

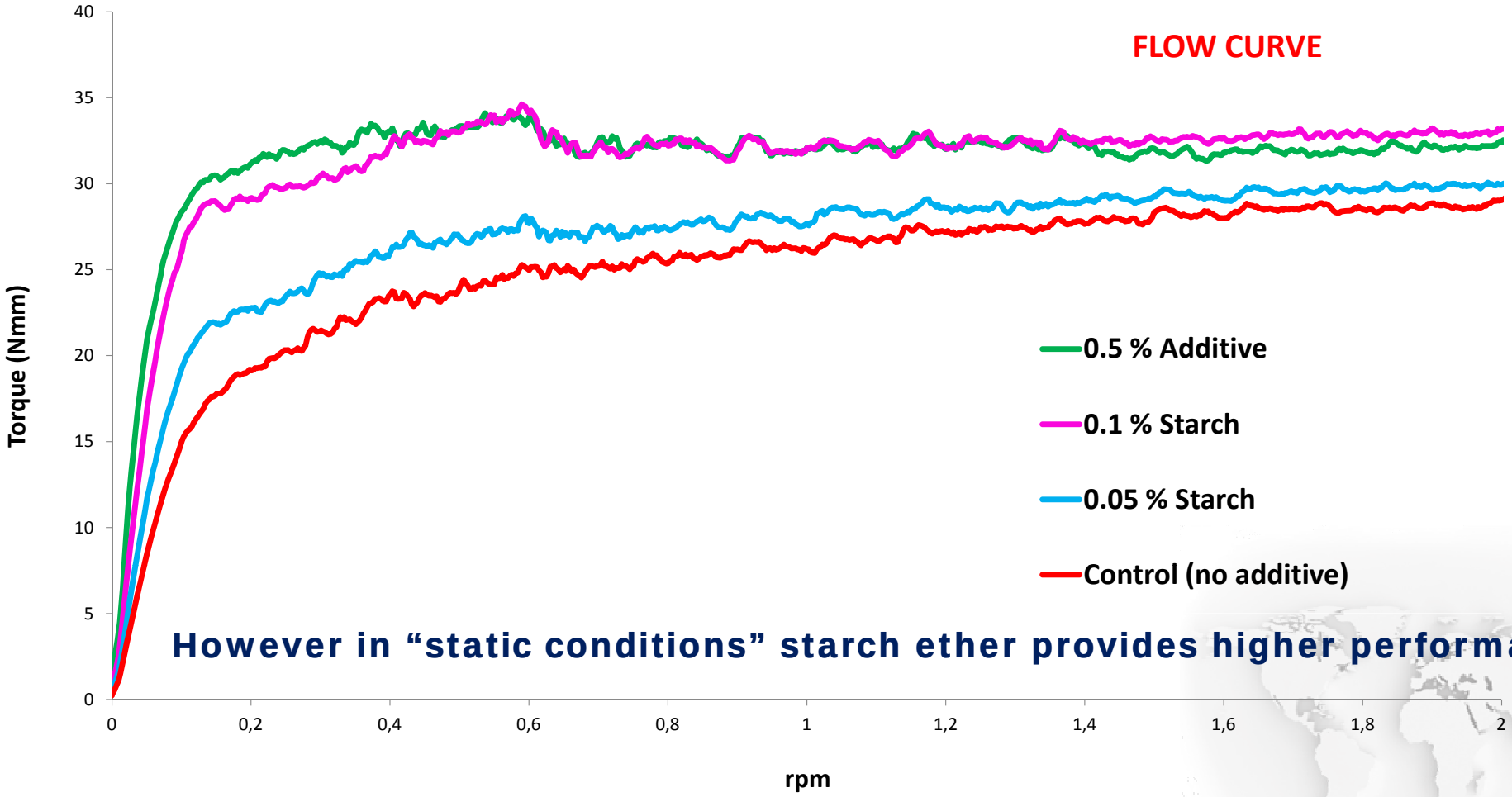


ORGANIC THICKENERS: NET BEHAVIOR

No gel capacity in “dynamic conditions” of starch ethers is observed



ORGANIC THICKENERS: FLOW CURVE



However in "static conditions" starch ether provides higher performance

ORGANIC THICKENERS

- While mortars with mineral thickeners additives have an increase in the sag control capacity when shear stress is decreasing, starch ethers do not. Starches are not able to form as stable three dimensional structures under low shear conditions.

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2- FLOW TABLE MEASUREMENTS

3- GEL FORMATION CAPACITY

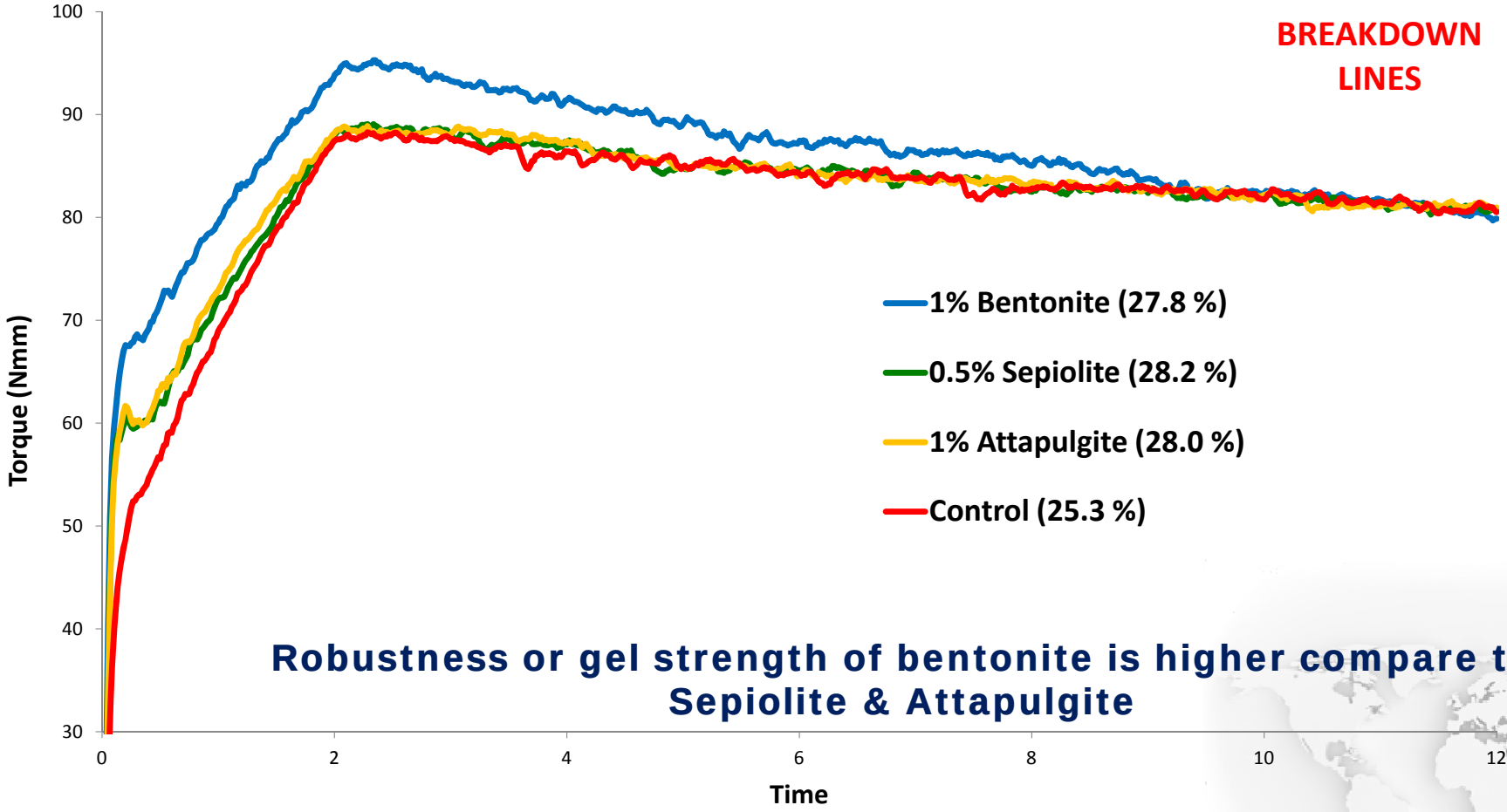
4- SEDIMENTATION CONTROL CAPACITY

5- ORGANIC THICKENERS

6- RHEOLOGY OF SEPIOLITE vs. BENTONITE

7- CONCLUSIONS

RHEOLOGY OF SEPIOLITE vs. BENTONITE



Robustness or gel strength of bentonite is higher compare to Sepiolite & Attapulgite

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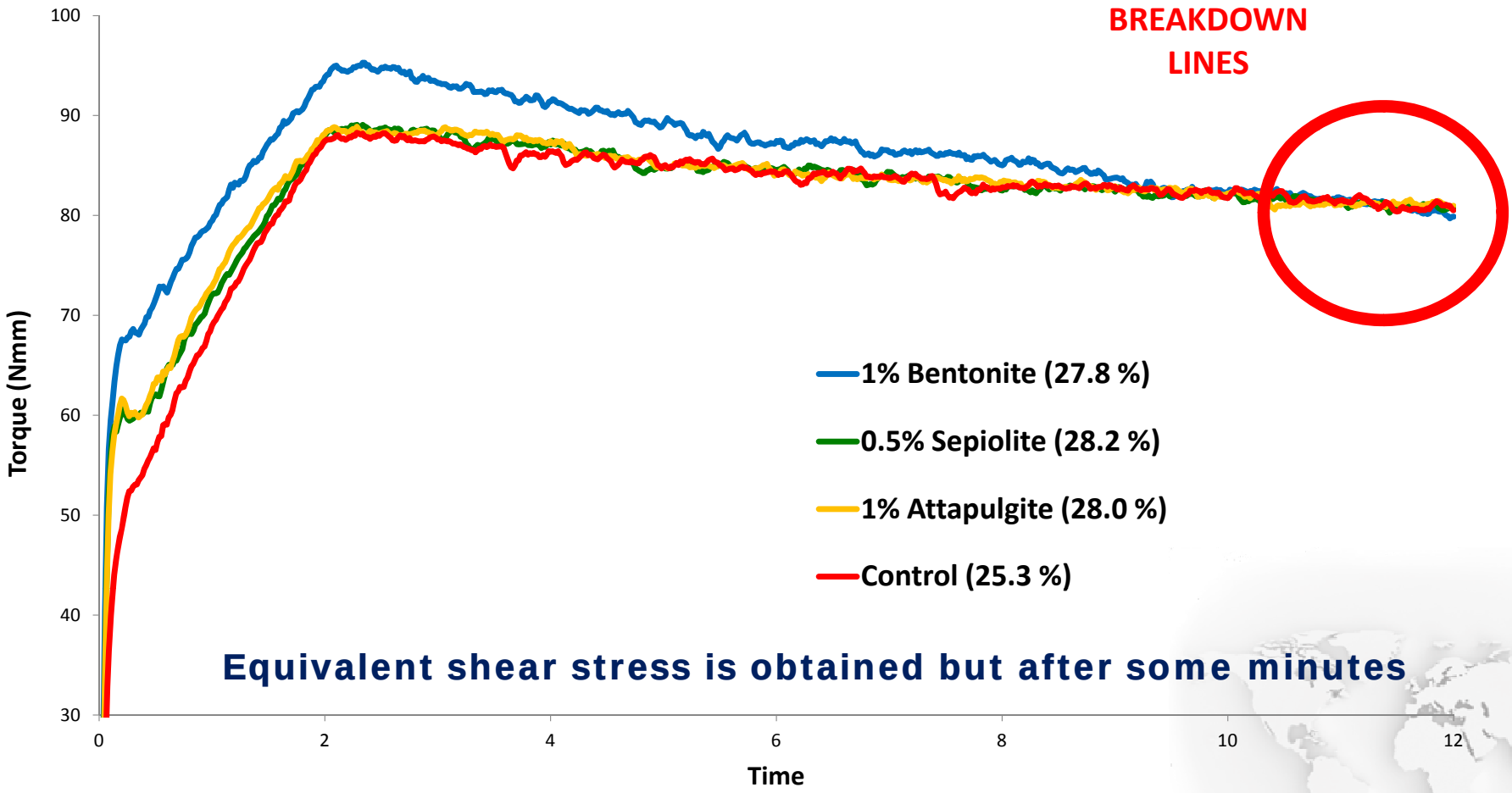
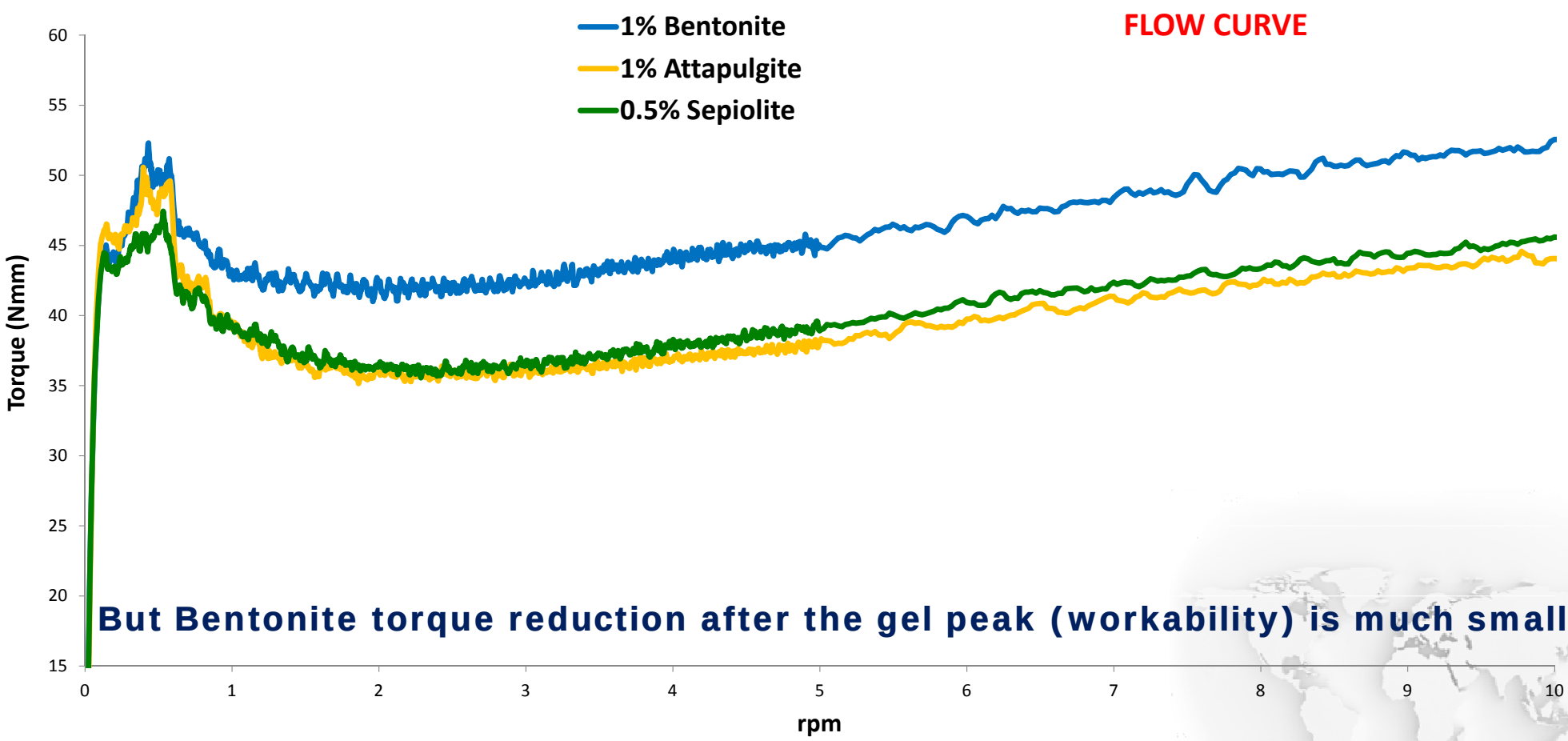
RHEOLOGY OF SEPIOLITE vs. BENTONITE



RHEOLOGY OF SEPIOLITE vs. BENTONITE



But Bentonite torque reduction after the gel peak (workability) is much smaller

RHEOLOGY OF SEPIOLITE vs. BENTONITE

- Strength of Bentonite gels are higher than the one shown for sepiolite, so Bentonite provide better slip or sag control under static conditions, but sepiolite achieve better workability at similar magnitude of the gel formed.

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2- FLOW TABLE MEASUREMENTS

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6- RHEOLOGY OF SEPIOLITE vs. BENTONITE

7- CONCLUSIONS

CONCLUSIONS I

- Flow table test could not be the most accurate method to verify water demand under shear stress.

- Rheometers could also be an interesting way of testing the water absorption.

- Net gel formation capacity of mineral thickeners when the shear rate is decreasing could be quantify.

- The gel peak gives information about sag/slip control and sedimentation resistance.

CONCLUSIONS II

- Workability could be quantified.

- Starches are not able to form as stable three dimensional structures under low shear conditions.

- Sepiolite and Attapulgite gels provide better workability and gel formation capacity than bentonites, but betonites give better sagging and slip control at static conditions.

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