Workshop:
The role of drilling mud in the borehole

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Quelle: Phrikolat

Workshop - The role of drilling mud in the borehole

Why that topic?

Experts on board

- Henning Söker (AMC Europe, Germany)
- Krzysztof Dębicki (Heads, Poland)
- François Gandard (Optimum, France)

Goal of the workshop

Quelle: Phrikolat

Workshop - The role of drilling mud in the borehole

Contents

- Purposes/functions of drilling fluids
- Requirements of drilling fluids
- Performance of drilling fluids and limits
- Monitoring, surveillance and checking on site
- Drilling mud losses and blow outs
- Preventing circulation problems
- ???

Quelle: Phrikolat

Workshop - The role of drilling mud in the borehole

Some remarks…

- It´s a workshop!
- Only 60 min workshop + 15 min break + 45 min workshop
- Participants with different background and level of experience
- Possible *DCA Members-Forum* about that topic
- Short summary of the workshop given tomorrow and published on DCA-website

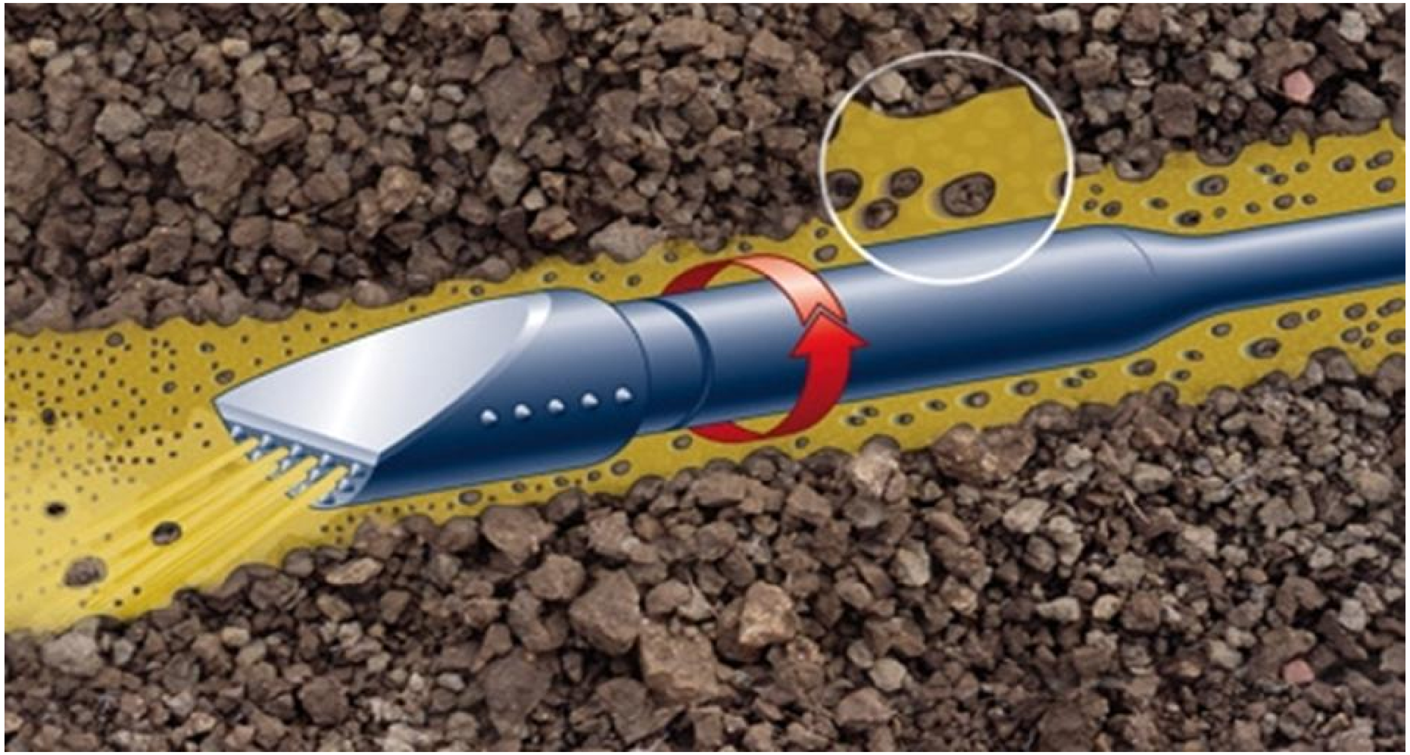
Quelle: Phrikolat

Purposes/functions of drilling fluids

- Transport of cuttings
- Keeping cuttings in suspension
- Stabilisation of the borehole (Inhibition, Fluid Loss)
- Transfer of hydraulic energy
- Cooling the drilling tools
- Lubrication
- Downhole pressure control
- Providing geological information about the formation

Classification | Public

Transport of cuttings and Keeping cuttings in suspension



Quelle: Süd-Chemie

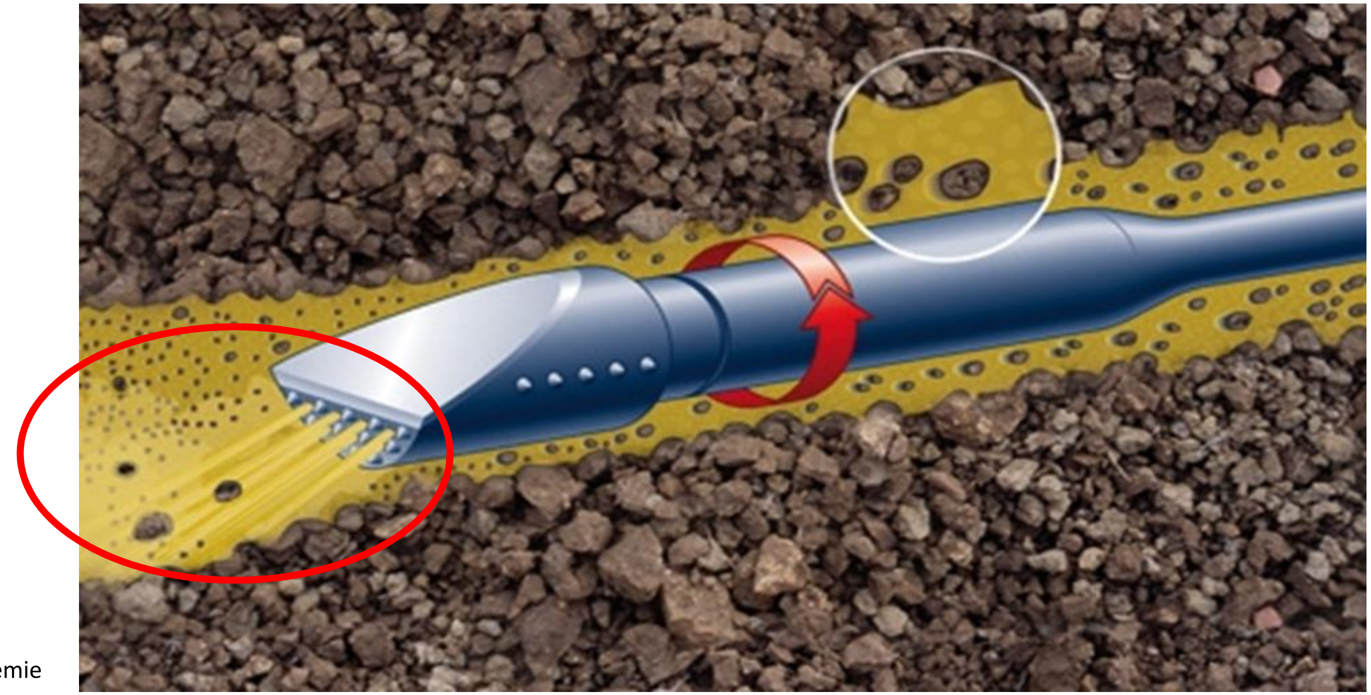
Cuttings transport & sustain

Stabilisation of the borehole

Video

Transfer of hydraulic energy

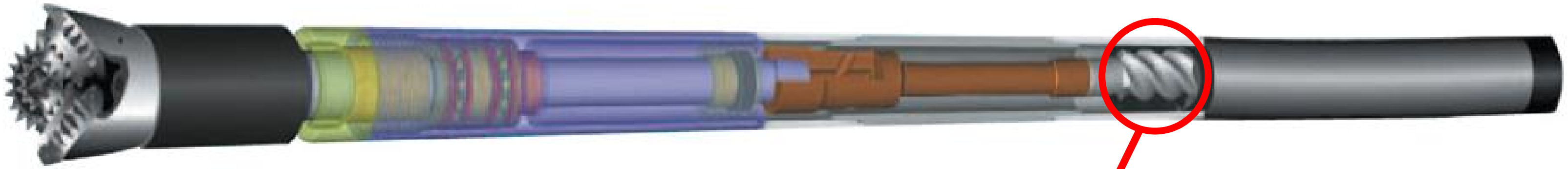
- Break the formation at the working face



Quelle: Süd-Chemie

Transfer of hydraulic energy

- Powering mud motors



Cooling the drilling tools

Lubrication

Downhole pressure control

Providing geological information about the formation

Requirements for drilling fluids

- Environmental friendly
- High quality of products
- Ability for recycling
- Easy to mix and to use
- Cost effective

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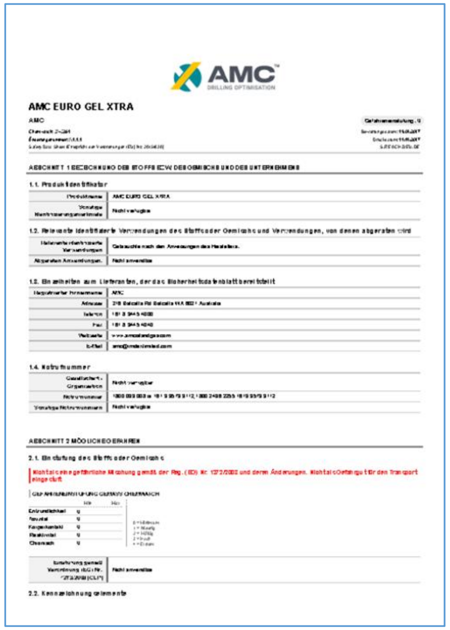
Environmental compatibility of additives

- PDS, SDS, Certificate of environmental safety (harmlessness)




DAkkS
HuK Umweltlabor GmbH

Zertifikat über Umweltunbedenklichkeit

Produktbezeichnung : EURO-GEL Xtra

Hersteller : AMC Germany GmbH
Industriepark 7
D-27777 Ganderkesee

Deutschland

Tel.: 04402 / 6950-0
Fax.: 04402 / 6950-59

Die an dem Produkt EURO-GEL Xtra durchgeführten chemisch-physikalischen Untersuchungen haben ergeben, dass nach heutigem Kenntnisstand, aus umwelttechnischer Sicht, bei dessen Einsatz als Spülungssuspension, keine Beeinträchtigung von Schutzgütern zu besorgen ist.

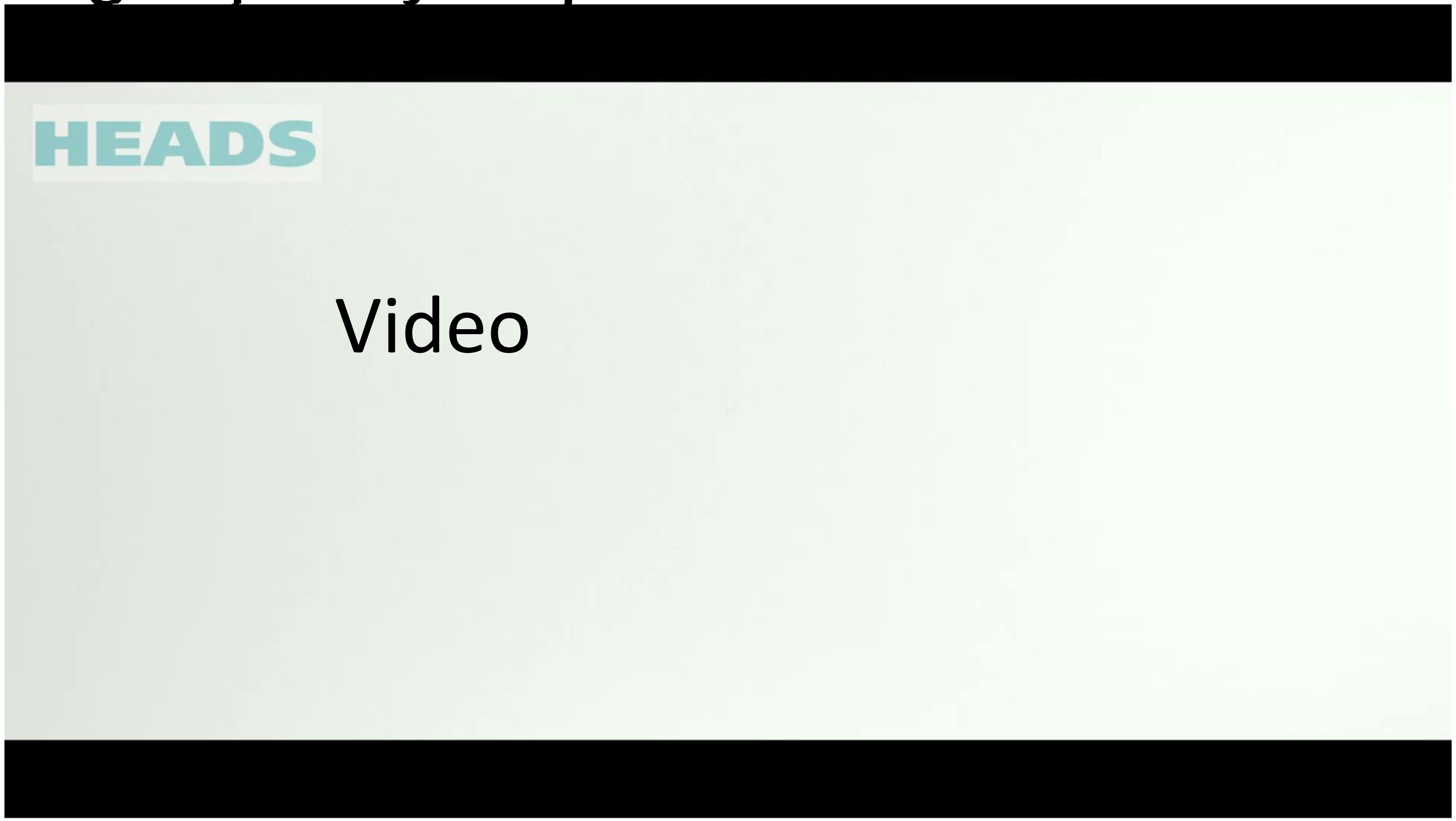
Dieses Zertifikat ist gültig bis 06.02.2017. Die umweltrelevanten Kontrolluntersuchungen werden jährlich durchgeführt.

HuK Umweltlabor GmbH Hünsborn, den 07.02.2013

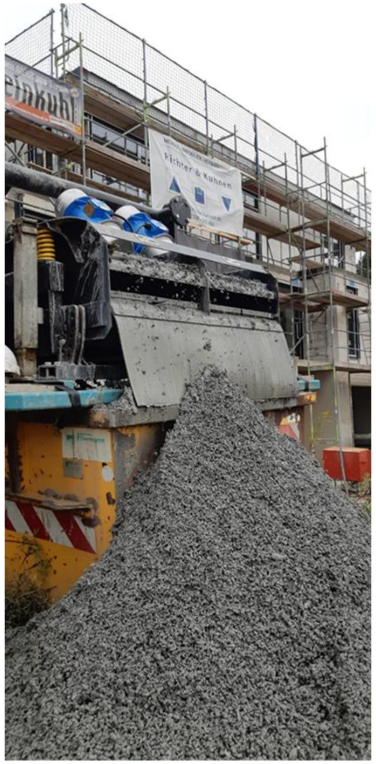
Dr. William Kwarteng Dr. Lars Füchtjohann

Unternehmensgruppe Horn & Co.

High quality of products



Suitability of drilling fluids for reprocessing (recycling)



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Performance of drilling Fluids

- Fit for purpose (adapted to geology/formation, well geometry)
- Rheological Properties (shear thinning, hole cleaning)
- Low Density
- Fluid Loss (filtercake)
- Inhibition
- Lubrication
- Surfactant

Technical limits of performance


Quelle: Phrikolat


Quelle: Phrikolat


Quelle: Phrikolat




Technical limits of performance

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Investigation of properties/parameters on site

- Mud density
- Solids/sand content after recycling
- Rheological parameters (Viscosimeter)
- Marsh Funnel Viscosity
- Fluid Loss / Filter Cake
- Chemical properties: pH, Hardness, Chlorides, etc. (Fluid and make up water)

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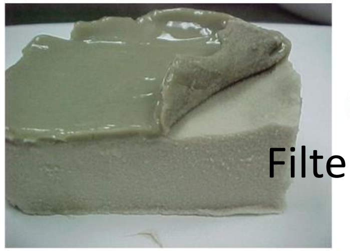
Investigation of properties/parameters on site

Viscosimeter

Sand content

Marsh funnel



Filter cake

Mud density

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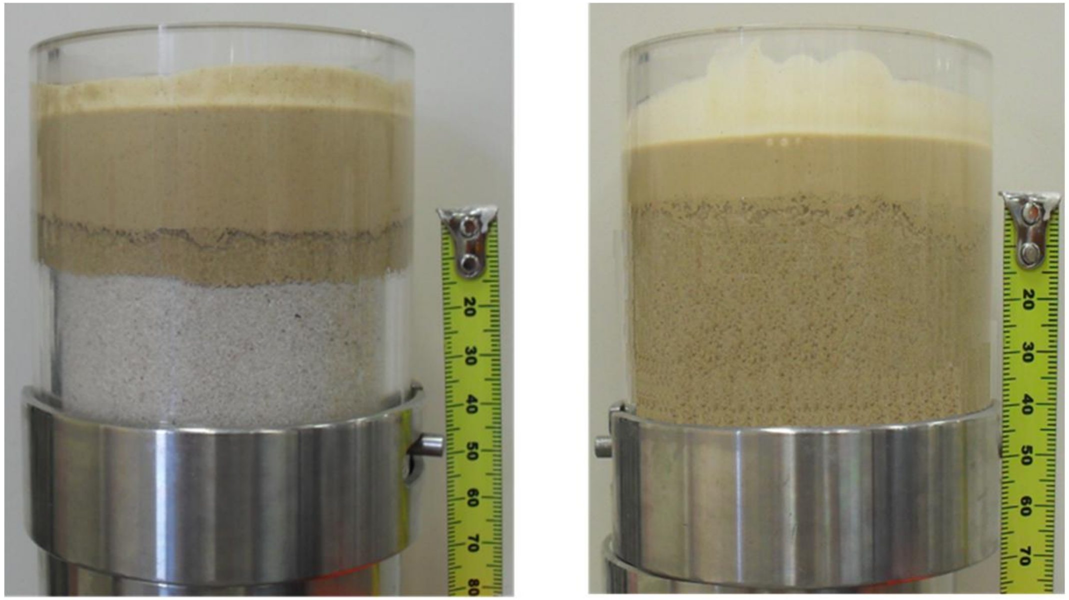
Investigation of properties/parameters on site

- Stabilisation of the borehole (Fluid Loss - Filtercake)



20/40 frac sand; 100psi/30min

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Parameters to be measured on site according to the complexity of the HDD project

		WATER		DRILLING FLUID								
		pH	Hardness	Density	Sand Content	Marsh Viscosity	Plastic Viscosity	Yield Point	Gel Strenght		Filtrat	
									10s	10min	Filtrat	Cake
Unit		1 to 14	mg/l	-	%	s	cPS	lb/100ft²	lb/100ft²	lb/100ft²	ml/30min	mm
Target	*In*	8.5 - 9.5	< 100	As low	As low < 0.3	35 à 75	As low as possible	As high as possible	As high as possible	A close as possible from the 10s value	As low as possible	As low as possible
	Out			< 1.30	15 to 30		5 à 20	15 à 50	0 à 10	15 à 50	10 à 40	1 à 3
HDD < 100m REAMING < 300mm		YES	YES	NO	NO	NO	NO	NO	NO	NO	NO	NO
100m < HDD < 500m 300mm < REAMING < 650mm		YES	YES	YES	YES	YES	NO	NO	NO	NO	NO	NO
500m < HDD 650mm < REAMING		YES	YES	YES	YES	YES	Depending on the complexity of the project, engage the services of a specialized engineering firm to define a mud program and ensure the presence of mud technicians on site to follow the program.					

Basic parameters to be measured and target values

	Unit	Target	Risk	Corrections
pH	1 à 14	8.5 - 9.5	Poor hydration of the viscosifying agent	Add Soda Ash to adjust the pH
Hardness	mg/l	< 100	Poor hydration of the viscosifying agent	Add Soda Ash to adjust the Hardness
Density	-	< 1.3	Downhole overpressures (blowouts) Pumping issues Poor hole cleaning	Use the adequate reclaimer Add a centrifuge in the process in case of clay Dump the fluid
Sand Content	%	< 0.3%	Damages on the HP Pump ($)	Use the adequate reclaimer
Marsh Viscosité	s	35 - 75	Too low : bad transportation Too high: overpressures and pumping issues	Ajust the composition by the mud technician Use the adequate reclaimer Add a centrifuge in the process in case of clay

How much am I cleaning the hole?

Solid Content: % returns - % fluid in

1- Density increasing $60 \cdot (d_{out} - d_{in})$

2- Sand Content $SC_{out} - SC_{in}$

Volume of solids evacuated from the hole during a given pumping period:

$$V_S = T_{se} \cdot Q \cdot t$$

With

VS :	*Volume of solid evacuated*	*[liters]*
T_{se} *:*	*Rate of solid out of the hole*	*[%]*
	$= 60 \cdot (d_{out} - d_{in}) + (SC_{out} - SC_{in})$	
Q :	*Pumpingrate*	*[liters/min]*
t :	*Pumping time*	*[min]*

The role of drilling fluid losses and blowouts


Quelle: Phrikolat


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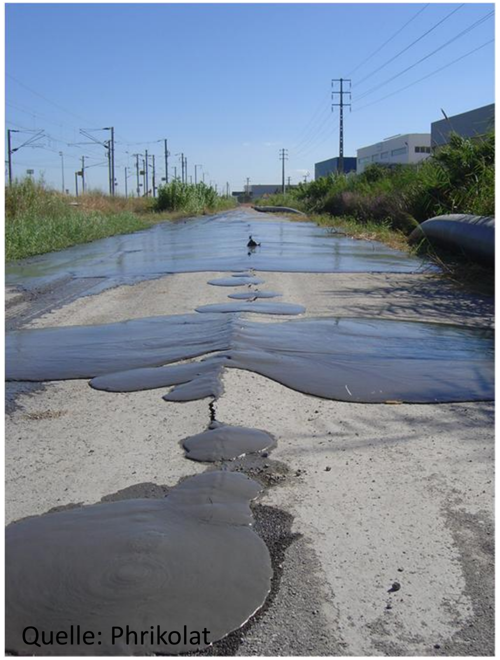
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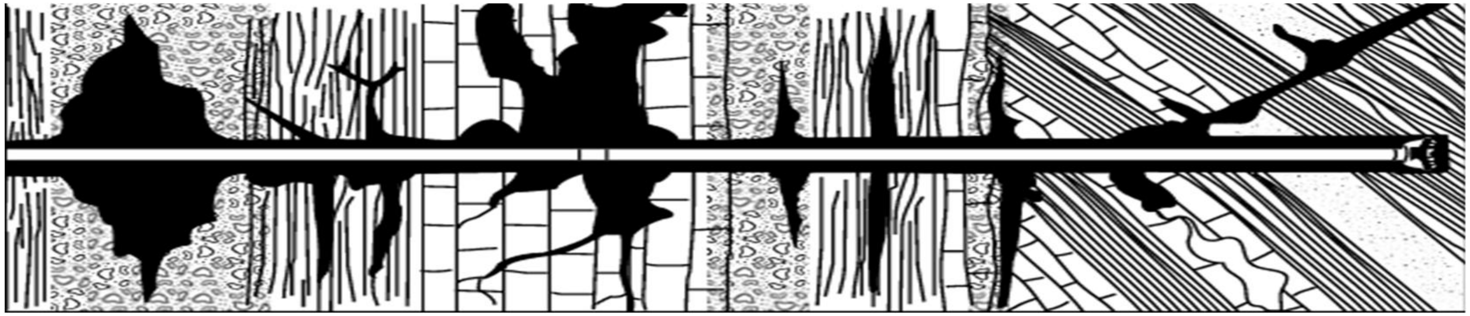
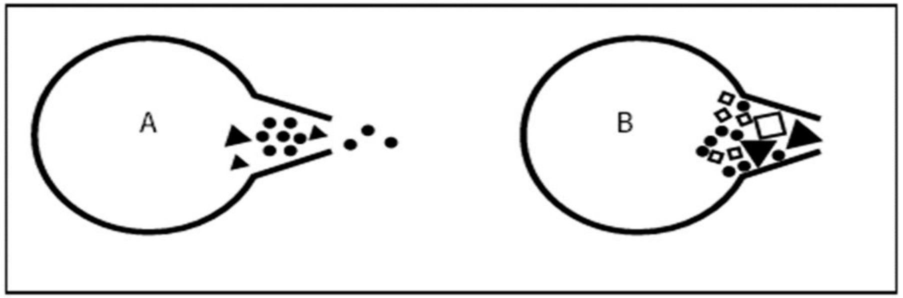
The role of drilling fluid losses and blowouts

Reasons for mud losses in rock formations



Scourings *Caverns* *Fissures* *Fractures*

LCM
(Lost Circulation Material)



Mud losses can lead to:

- unstable boreholes
- increased mud costs
- loss of time and high standby costs
- abandonment of drilling projects

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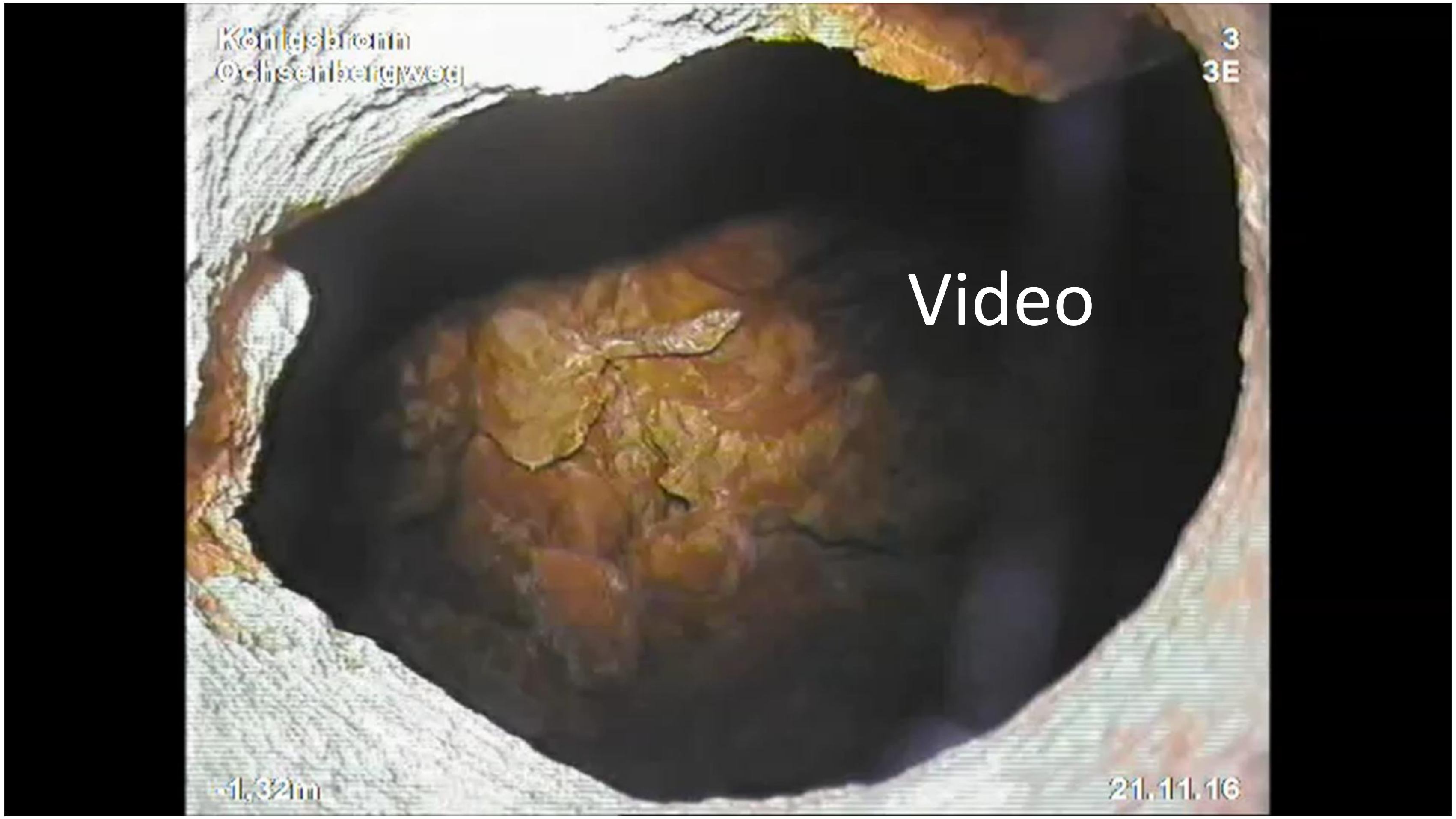
Königsbronn
Ochsenbergweg
2
2E
STOP > 25 Grad
Video
9,94m
03.11.16



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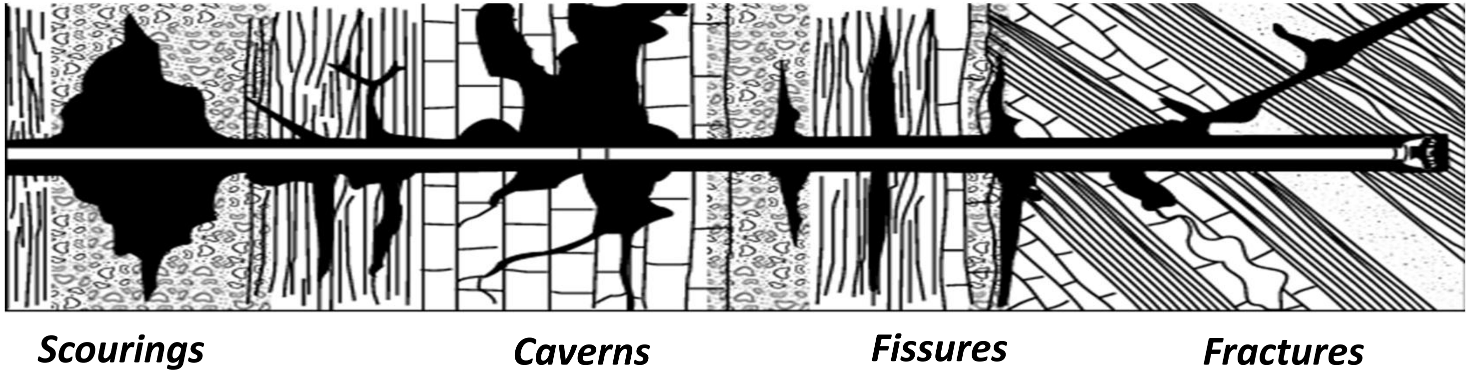
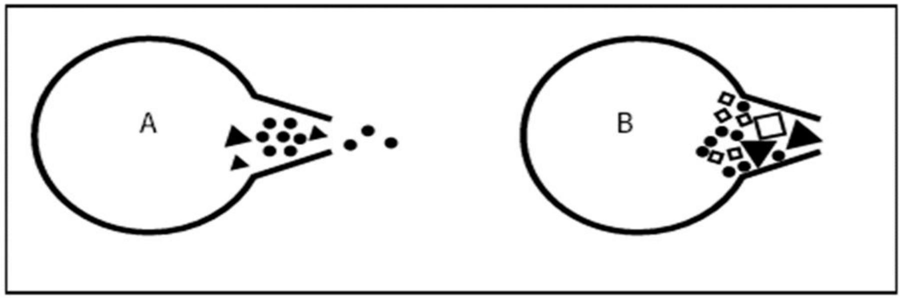
LCM (Lost Circulation Material)





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LCM (Lost Circulation Material)

- Gradual (seapage) and total losses of mud can be combated by the use of stoppers (lost circulation material = LCM)
- Hard plugging agents Cement, cement-bentonite mixtures
- Soft plugging agents Superabsorbers, mineral fibres, sawdust, mica, chalk, mussel shell...

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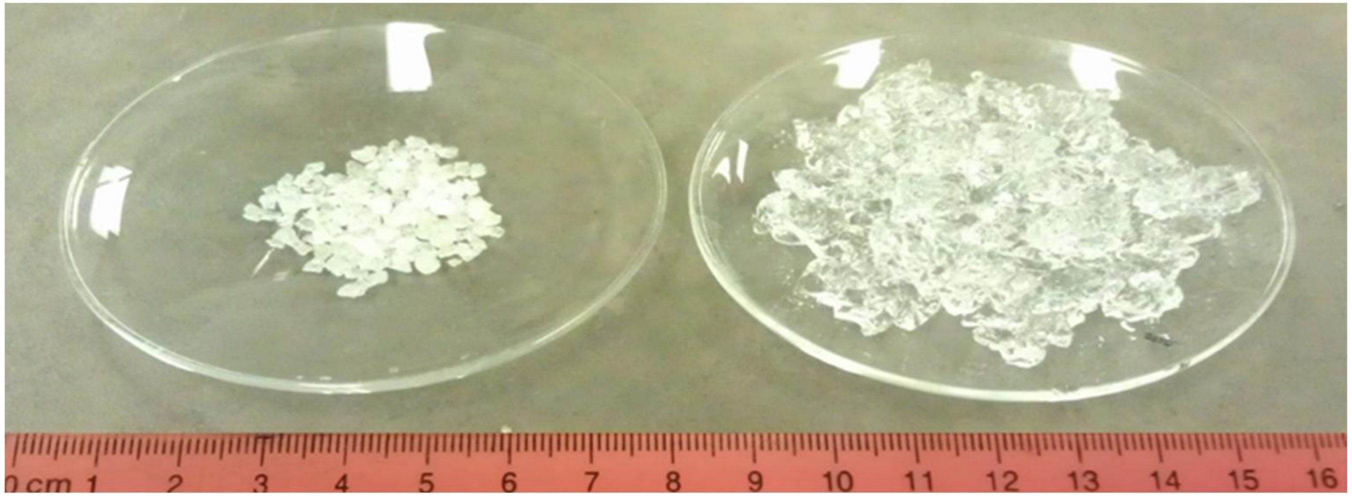
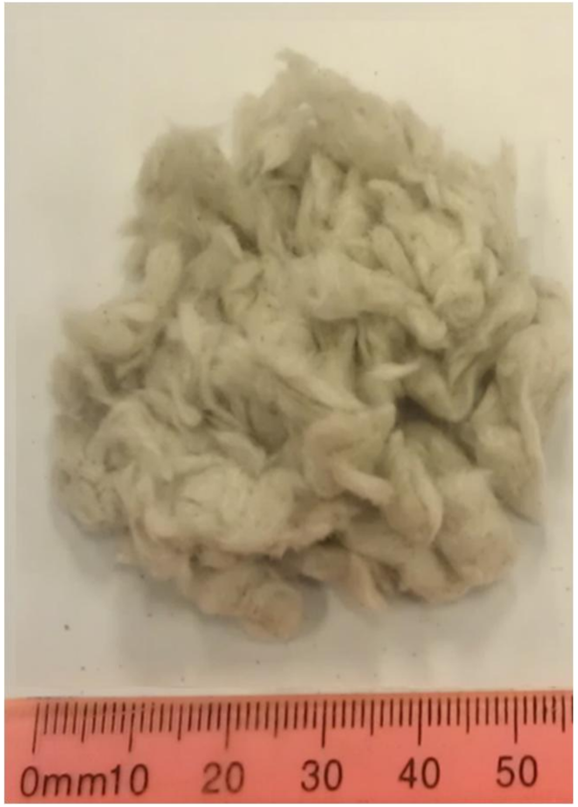
LCM (Lost Circulation Material)

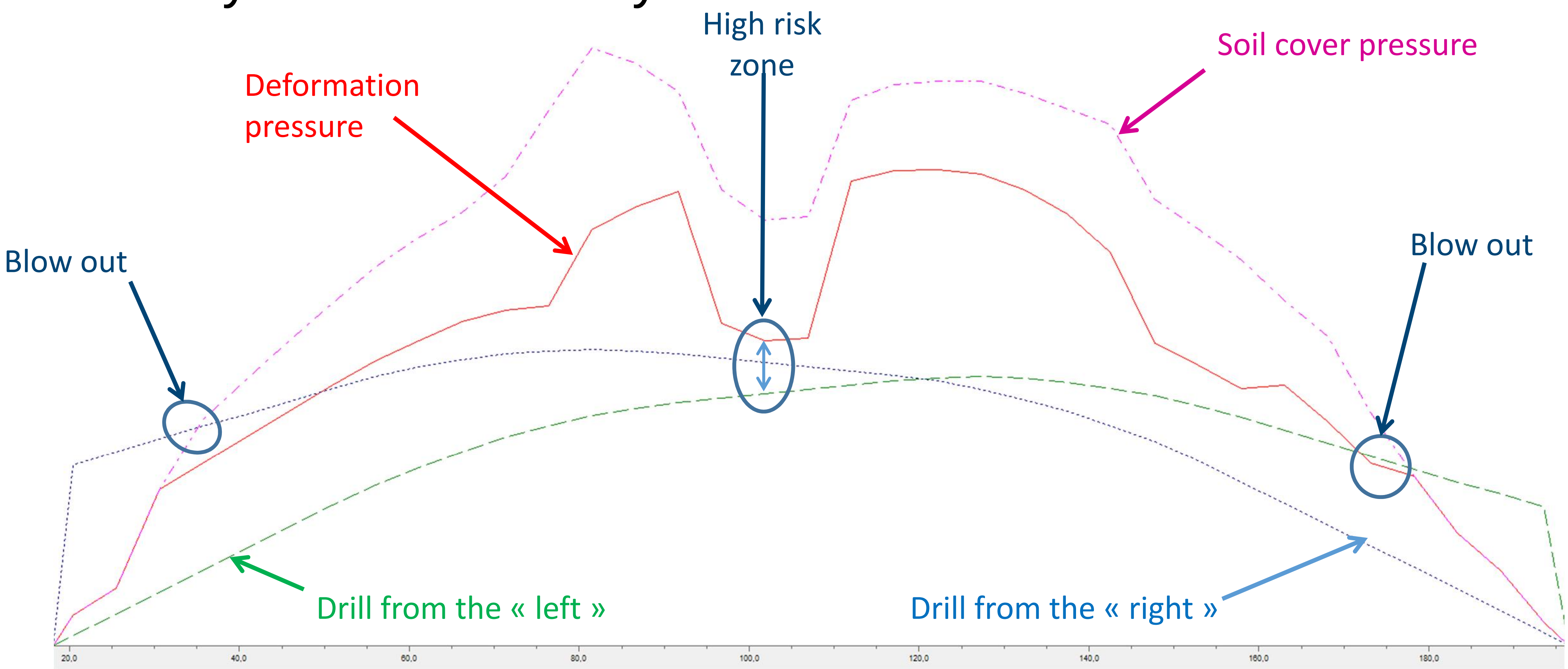
Mineral Fiber

Superabsorber

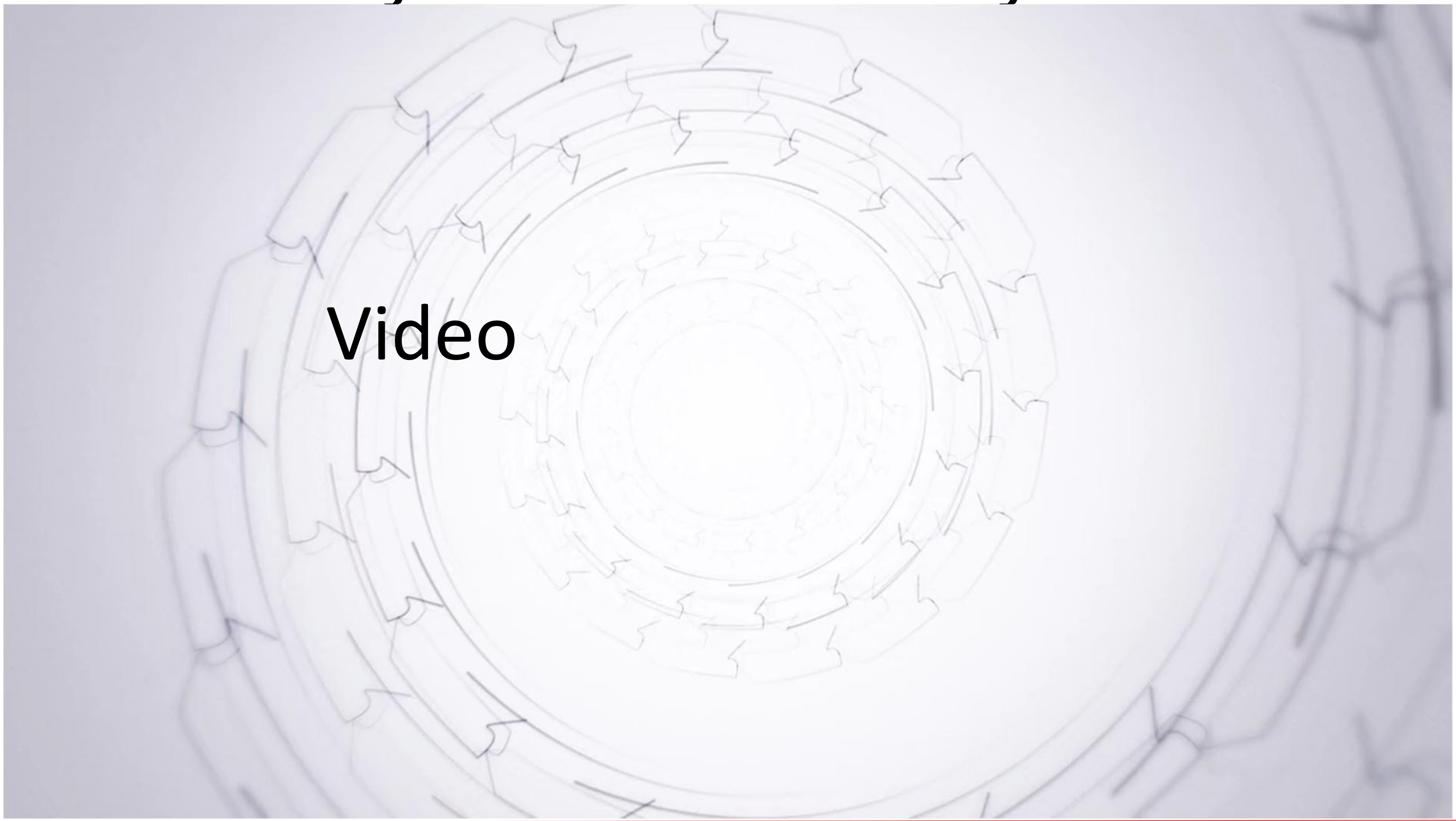




Focus on hydrofracture analysis



Focus on hydrofracture analysis



Preventing circulation problems

The purpose of a proper designed drilling fluid is to protect us from a problem, not to save us from the trouble that we have been already made by ourselves

- Drilling profile consulting
- Drilling fluid suits soil conditions
- Soil investigation
- Mixing water analysis
- Proper drilling fluid during project

Volume of fluid produced during pullback

Volume = Surface . Length = $(\pi \cdot \frac{D^2}{4}) \cdot L$

With *V :* *Volume in* m^3

D : *Diamètre in m*

L : *Length in m*

Volume = $\frac{D^2}{2} \cdot L$

With *V :* *Volume in liters*

D : *Diameter in ''*

L : *Length en m*

When pulling back, remember that the volume of drilling fluid that **will exit** from the hole is equivalent to the volume of the pipes introduced

=> This volume must be available on surface before pullback

Some conclusions

- A proper disigned drilling fluid can prevent you from many problems but it does not solve most troubles that occured already

- Comprehensive upfront information and planning is required to ensure a good performance of drilling fluids

- Small-scale drillings often require less care in regard with drilling fluids and often less surveillance