LIQUID SOIL ACCORDING TO RAL QUALITY MARK 507

planning, production, placement and quality assurance

FiFB
Forschungsinstitut
für Flüssigboden GmbH

RAL
GÜTEZEICHEN
FLÜSSIGBODEN
PRÜFSTELLE

LIQUID SOIL since 1998

IKT Gelsenkirchen, 5 Sept 2017, Olaf Stolzenburg, Quality Committee of the RAL Quality Association Liquid Soil

01 Origin of the RAL Quality Association Liquid Soil
(RAL Gütegemeinschaft Flüssigboden e. V.)

02 Purpose and function

03 Objectives

04 Quality and Testing Specifications suitable for applications of liquid soil

- What is liquid soil according to RAL-GZ 507
- Application range of liquid soil – need for effective quality assurance
- Quality assurance process as a suitability test for a process application

05 Summary

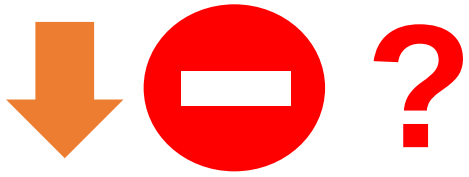
Around the year 2000, temporarily flowable backfill materials (after the year 2007 also called "ZFSV" – English "TFSB") are becoming more and more important for the construction of sewers, underground constructions, road and hydraulic engineering.
Some suppliers often call these materials "liquid soils", which is very generalizing, and unfortunately causes many problems.

Also the liquid soil method, that triggered the work of our Quality Association, was originated during that period almost 20 years ago and for the first time allowed the reuse of all types of soil via the interim state as liquid soil, even humin-contaminated soils, and thus fulfilled the Waste Management and Product Recycling Act.

01 Foundation of the RAL Quality Association Liquid Soil (RAL Gütegemeinschaft Flüssigboden e. V.) in 2008

There was a Babylonian chaos with the concepts – which was possibly even desired by some suppliers.

Liquid soil or TFSB?



- no clear definitions existed
- lack of directives and quality standards
- many suppliers had no or only little practical experience

For many, it seemed to be an attractive market with relatively low entry barriers.

There seemed to be a great product diversity and competition seemed to be given – without knowledge about the new method!

RESULTS: DAMAGES RESULTING FROM RELEVANT DIFFERENCES OF THE MATERIALS PROVIDED, AND PROCESS-RELATED FAULTS IN THE APPLICATIONS

IKT Seminar

Liquid soils – application fields in conduit trenches

5 Sept 2017 – Gelsenkirchen, Germany

01 Origin of the RAL Quality Association Liquid Soil (RAL Gütegemeinschaft Flüssigboden e. V.)

Damages and application errors

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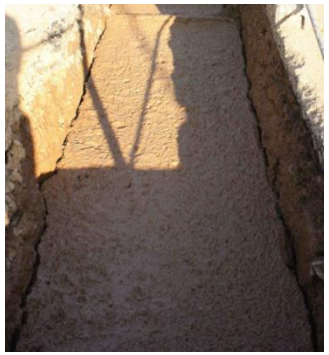
01 Origin of the RAL Quality Association Liquid Soil

Damages and application errors



01 Origin of the RAL Quality Association Liquid Soil (RAL Gütegemeinschaft Flüssigboden e. V.)

almost 10years ago, in spring 2008:

initiated by customers, planners, and experts as their representatives

The following cities play a pioneering role:

Stadtentwässerungsbetrieb Landeshauptstadt Düsseldorf

STADTENTWÄSSERUNG GÖTTINGEN

KWL KOMMUNALE WASSERWERKE LEIPZIG GMBH

01 Origin of the RAL Quality Association Liquid Soil

2008:
Foundation of the RAL Quality Association Liquid Soil

as an independent institution for the assurance of defined quality standards in the application of the new liquid soil method, developed from 1998 on, and all its further developments in the form of techniques, technology and many new applications.
As a result of the applicability of the new method for all interested parties on equal terms, the Quality Association was approved by the RAL German Institute for Quality Assurance and Labelling (RAL Institute, RAL Deutsches Institut für Gütesicherung und Kennzeichnung e. V.) and the right to award the quality mark 507 (RAL-GZ 507) was awarded to the Quality Association.

RAL Simply Excellent.

... RAL quality marks have been awarded for particularly high-quality products and services for over 90 years – according to objective criteria and in a neutral way. RAL is the only awarding office for quality marks in Germany, and in that capacity RAL defines the requirements for the respective RAL quality mark for each product and performance group... Source: www.RAL.de

02 Purpose and function

- Creation of objective and transparent standards for the high-quality application of the liquid soil method
- Transfer of the necessary specialist knowledge
- Support for further development
- Support for the development of new technological and technical solutions
- Development of the necessary exchange of experience
- Quality assurance based on scientifically substantiated procedural knowledge

03 Objectives

An active partner in solving key socio-political challenges:

- **Urban development / cities of the future** – flexible, yet long-lasting solutions of future infrastructure systems in the increasing location competition are in demand
- **Energy revolution** – long-term security of the energy supply and chance to "clean up" the underground construction spaces
- **Climate change** – innovative partner for flood protection concepts and for a noticeable reduction in CO_2 generation
- **Resource conservation** – fulfilment of the Waste Management and Product Recycling Act

IKT Seminar

Liquid soils – application fields in conduit trenches

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04 Quality and Testing Specifications – Liquid Soil according to RAL Quality Mark 507 (RAL-GZ 507)

Liquid Soil is not a product
but the application of a procedure

BUILDING IN WATER

UP TO 45° SLOPE

BUILDING UNDER WATER

SLOPE PROTECTION

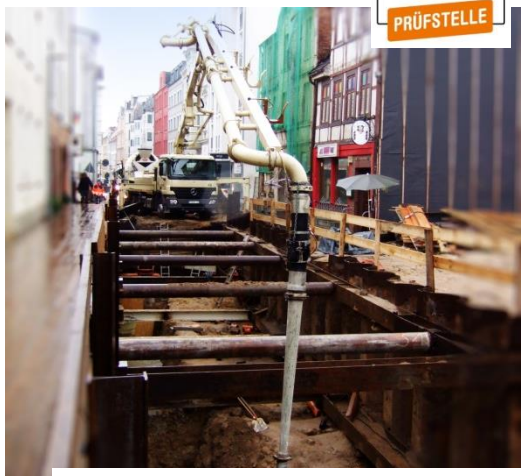
GROUND CABLE

FLOOD PROTECTION

04 Quality and Testing Specifications – Liquid Soil according to RAL-GZ 507

High quality standards can only be achieved through a holistic view of the value chain from planning to placement of the liquid soil!

COMBINED CONDUITS


NARROW CONSTRUCTION SPACES


BORED PILE FOUNDATION

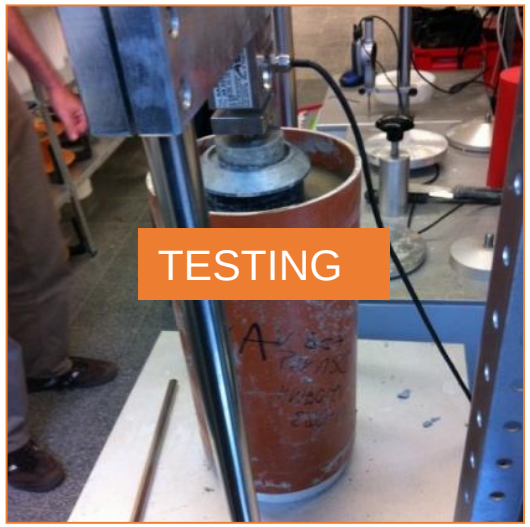

BASE PLATE

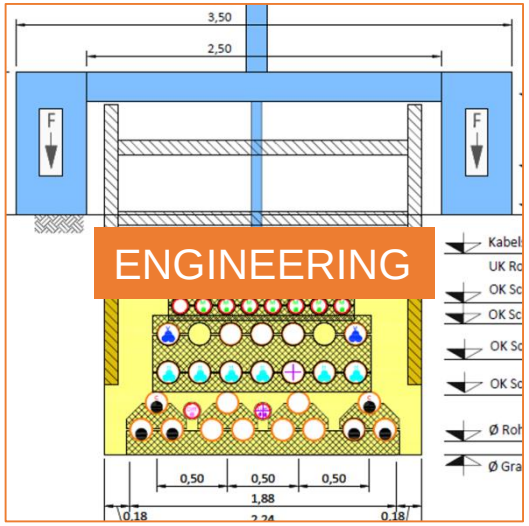
SLURRY WALLS

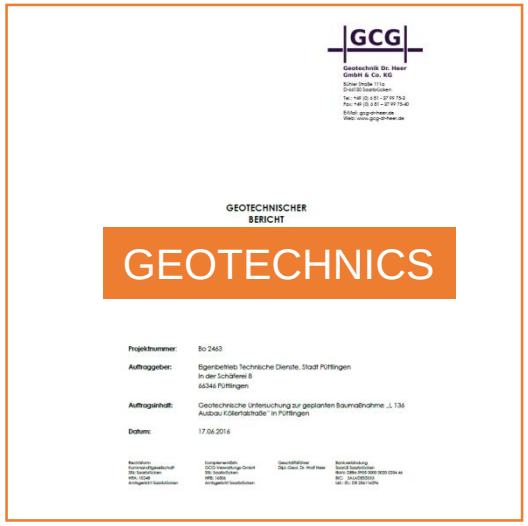

PIPELINE CONSTRUCTION

04 Quality and Testing Specifications – Liquid Soil according to RAL-GZ 507

This can only be achieved by the cooperation of all parties involved







04 Quality and Testing Specifications – Liquid Soil according to RAL-GZ 507

Key elements of Quality Assurance according to RAL-GZ 507

+ Liquid Soil according to the requirements of the **RAL Quality Mark 507** is a **frictional, cohesive, solidifying material** as one of the 2 groups of temporarily flowable, self-compacting backfill material (TFSB).

+ Liquid soil is the **result of the application of a method** which allows all common soils and aggregates to be brought into a flowable state temporarily.

= Subsequently, the soil solidifies with **controllable soil-mechanical**, **technologically relevant** and special **properties** and without external compaction work, as well as **without the formation of rigid foreign structures**, with the formation of the soil-typical behaviour of the initial soil.

= Thus, the restoration of the original, grown and undisturbed state of the excavated soil is possible. (see ZTVA 12 StB) Alternatively, the **3 groups of the properties of the liquid soil can be controlled in a targeted manner**, which can be specified by the planning for each project.

04 Quality and Testing Specifications – Liquid Soil according to RAL-GZ 507

Temporarily flowable, self-compacting backfill materials (TFSB)

frictional, cohesive solidification (liquid soil)

material without forcing, rigid foreign structures with QA to ensure procedural assurance

hydraulic setting materials

material with forcing, rigid foreign structures (eg cement stone structures) with QA as product assurance

Field of application

Regulation on RAL – Quality and Testing Specifications

No difference made in the FGSV information sheet on TFSB (2012)

This distinction was already made and published by the first head of the FGSV Working Group "ZFSV (TFSB) from Soil / Soil Substances", the chemist Michael Webeling in 2009! Accordingly, the term "liquid soil" is not used in the leaflet of the FGSV.

Source of the talk: "Quality assurance of temporarily flowable, self-compacting backfill materials", Berlin 2009

04 Quality and Testing Specifications – Process of quality assurance

PLANNING PHASE	1 Development and provision of ground investigation results	2 Specification of the target properties by planner and technical planner (liquid soil)	3 Preliminary mix design with defined properties and tolerances	4 Testing of samples for compliance with specifications	5 Approval of the mix design and thus acceptance of the liability by the mix design developer
CONSTRUC-TION PHASE	6 Production, control and document-ation of liquid soil according to approved mix design	7 Transport with suitable devices from mixer to pump, etc.	8 Placement according to technological requirements and with suitable devices	9 Documentation and verification including evaluation	

04 Quality and Testing Specifications – Process of quality assurance

1 Development and provision of ground investigation results

Compilation of the soil expertise depending on the targets of planners and specialist planners.
Ground survey according to EC 7 or DIN 18300 (homogenous areas) – classification according to geotechnical categories.

MINIMUM REQUIREMENTS EG FOR GK1 AND GK2	grain size distribution, largest grain size or D90, mass fraction with grain diameter < 0.065mm	bulk density / compactness or consistency, permeability coefficient, content of pores and water	content of organic substances, eg ignition loss, TOC, content of lime	constrained modulus, if neces-sary swelling, expansion and expansion pressure	soil chemistry and mineralogy
	shear strength parameters (friction angle φ', cohesion c', undrained cohesion cu)	soil groups according to DIN 18196 or respective national standards	For applications corresponding to geotechnical category 3, in addition to the minimum requirements, an indication of the expected ranges is of particular importance		

04 Quality and Testing Specifications – Process of quality assurance

2 **Mix design specifications by planner and technical planner (FB) with target values and permissible tolerances as the result of a check for the exclusion of structural damage**

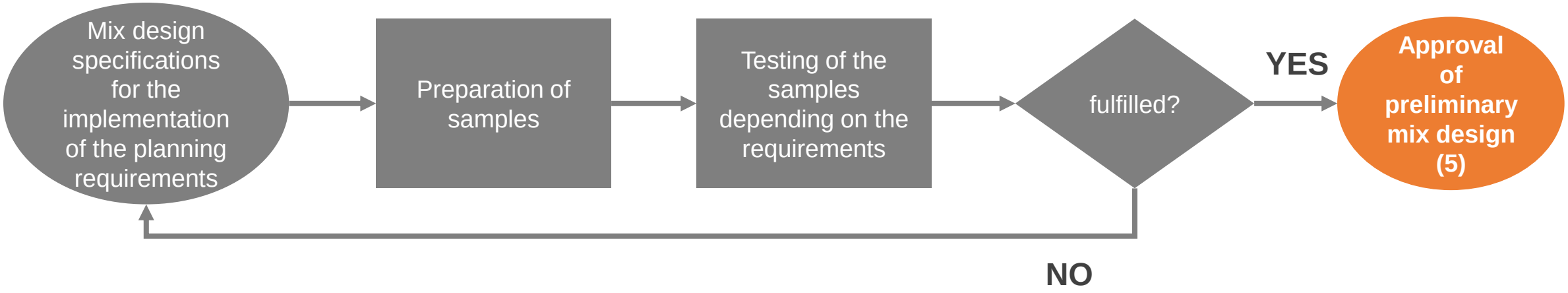
ALWAYS IN RESPECT OF THE SOURCE SOIL (SOIL EXPERTISE, SAMPLES), THE CONSTRUCTION WORKFLOW AND THE REQUIREMENTS TO THE RELEVANT CONSTRUCTION

Soil-mechanical properties	Technological relevant properties	Special performance properties
Physical parameters of the source soil relevant for later mechanical loads	• development over time of technologically relevant properties • control of rheology etc.	• heat transfer • friction • strength • vibration damping etc.

04 Quality and Testing Specifications – Process of quality assurance

3 4

Preliminary mix design and testing of the target values



5

Approval with assumption of liability by the mix design developer and instruction of the producer of the liquid soil

04 Quality and Testing Specifications – Process of quality assurance

6 7

Control and documentation Production / Transport

Who is allowed to produce and transport LS?	EVALUATION GROUP H1	EVALUATION GROUP H2	EVALUATION GROUP H3	EVALUATION GROUP H4
	all soil types – specific application-related requirements according to section 2.3 of the Quality and Testing Specifications according to RAL-GZ 507	natural aggregates, mixes of aggregates, and quality controlled recycling materials – specific, application-specific requirements according to section 2.3.2	all soil types – basic requirements for the production type according to section 2.3.1	natural aggregates, mixes of aggregates, and quality controlled recycling materials – basic requirements for the production method according to section 2.3

04 Quality and Testing Specifications – Process of quality assurance

6 7

Control and documentation
Production / Transport

Documentation (minimum requirements)	Liquid soil mix designs and form sheets for the collection of samples	Factory standard and user guidelines for liquid soil (system supplier)	Form sheets, instructions and protocols for the standardization of the quality assurance process
	Briefing documents for site-specific characteristics and procedures based on the Quality Assurance Plan (GSP)	Application-specific data sheets, leaflets, and information sheets for liquid soil (system supplier)	see appendix 7 Quality and testing specifications

04 Quality and Testing Specifications – Process of quality assurance

6 7

Control and documentation Production / Transport

	ongoing monitoring	self-monitoring	external monitoring
Production control / monitoring	Intervention in case of problems such as eg unplanned changes of the ground conditions or other technological require-ments of the construction site, etc. – by means of suitable production technology for handling of changing soils and other conditions.	Daily volume and expanded always after 500m³ liquid soil produced	At least after 3,000m³ of liquid soil produced and at least once a year

04 Quality and Testing Specifications – Process of quality assurance

8 Placement

Who is allowed to place LS?	EVALUATION GROUP A1	EVALUATION GROUP A2	OUTLOOK 2018
	placement of liquid soil produced from any material with specific, application-related requirements according to section 2.3.2	placement of liquid soil produced from any material with basic requirements according to section 2.3.1	New Quality and Testing Specifications are differentiated into 5 user groups in order to better meet the increased new application possibilities from more stringent engineering requirements and to enable the builder to make a more specific decision-making test to ensure the safe exclusion of defects.

04 Quality and Testing Specifications – Process of quality assurance

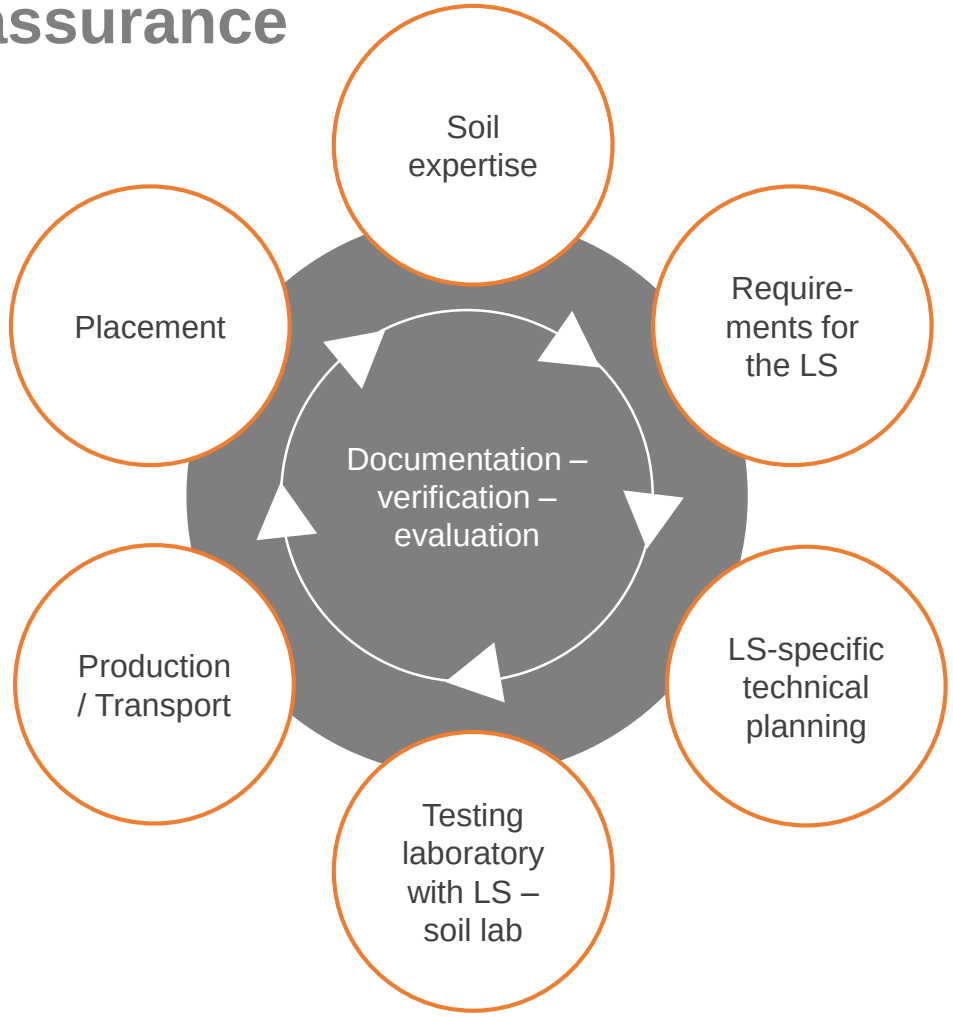
8 Placement

Control and quality assurance of the placement	Construction site preparation up to a coaching at the beginning of construction works by an expert trained for the respective application	Control of compliance with the quality assurance plan and ongoing adjustment as required	Proof of the employment of trained personnel	Proof of use of the appropriate, technical equipment
	Monitoring the how the mix design is adhered to before placement and reaction in case of deviations from the specifications for example diameter of flow	Intervention in case of problems due to changing boundary conditions of the construction site like soil, technology, logistics, etc.	Interface management between all parties involved, eg customer / planner, ground investigation expert, technical planner, testing laboratory, producer, user, etc.	Dealing with subcontractors eg when securing certain conditions of qualification and equipment

04 Quality and Testing Specifications – Process of quality assurance

9 Documentation – verification – evaluation

The process of quality assurance according to RAL-GZ 507 represents a cycle which includes the entire value chain.



05 Summary

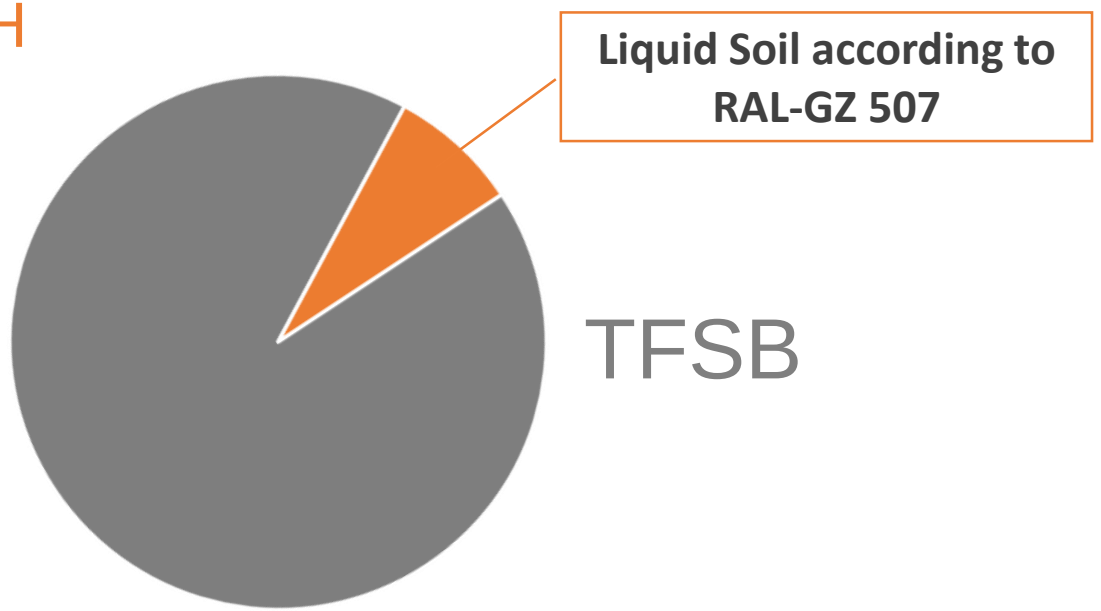
IN ORDER TO REACH HIGH QUALITY AND MAKE SURE NO DAMAGES OCCUR, THE OBSERVATION OF THE ENTIRE VALUE-ADDED CHAIN IS REQUIRED

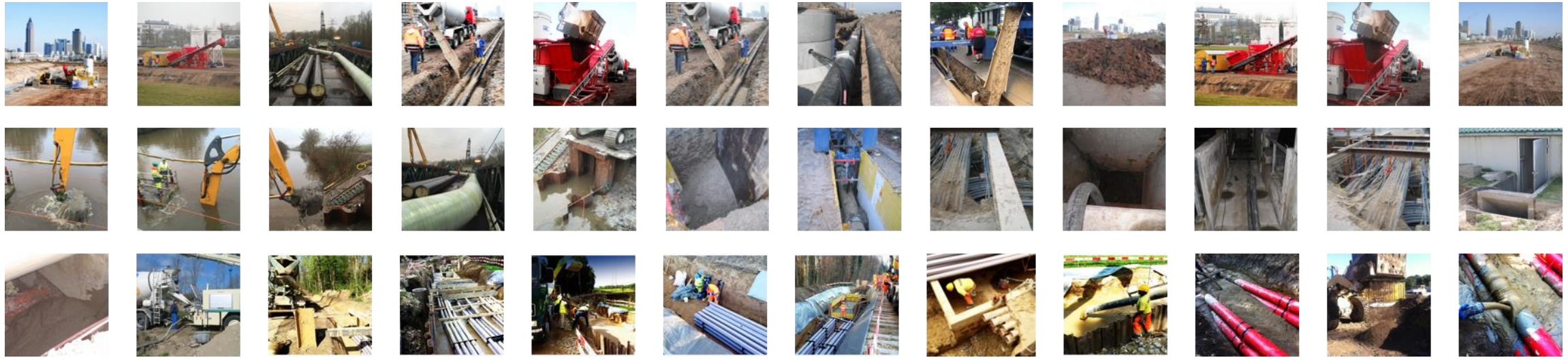
THEREFORE, LIQUID SOIL ACCORDING TO RAL-GZ 507 SHOULD **NOT BE CONSIDERED AS A PRODUCT** BUT AS **A PROCEDURE** WHOSE APPLICATION WITHOUT PRODUCING ANY DAMANGES MUST BE GARANTEED BY THE APPLICATION OF QUALITY ASSURANCE ACCORDING TO RAL-GZ 507

05 Summary

TFSB ≠ Liquid Soil according to RAL-GZ 507

LIQUID SOIL ACCORDING TO RAL-GZ 507 IS ONLY **A SUBGROUP OF TFSB** AND AS SUCH ITS APPLICATION MUST BE ACCOMPANIED BY A QUALITY ASSURANCE PROCESS WHICH IS SUITABLE TO SAFELY AVOID STRUCTURAL DAMAGE WHEN THE LOCAL SOIL IS USED AND THE GROUND CONDITIONS ARE CONSIDERED.





THANK YOU

www.Fi-FB.de

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