



Examination of Construction Materials for Extraction Tanks

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IMI TAMI – ICL Central R&D

Who is IMI TAMI?



- The largest institute for industrial R&D in Israel.
- Founded 1952, Currently ~115 staff.
- Owned by ICL Corp. since 1975.
- Central R&D for ICL Group.
- Contract R&D for External Clients.
- Custom sample preparation including GMP.
- Wide range of analytical services.

IMI TAMI – ICL Central R&D - Corrosion Group

Provides services, consulting and technical support to ICL plants and external customers



Standard working methods

The Corrosion Laboratory operates under ISO 9001 certification. Testing is performed following ASTM and other standardization authorities' methods.

Fields of Activity

- Monitoring the development of corrosion in various working environments.
- Trials of a wide range of construction materials, including recommendations for suitable structures.
- Characterization of corrosion products and scale.
- Comprehensive failure analysis.

IMI TAMI – ICL Central R&D - Corrosion Group

Provides services, consulting and technical support to ICL plants and external customers



Our target customers

- Suppliers of chemicals and plastic products.
- Power stations and cooling towers.
- Industrial plant constructors.
- Manufacturers of desalination and water treatment plants.
- Manufacturers of construction paints.
- Manufacturers of concrete flooring for chemical plants.
- A wide range of clients that have corrosion problems.

Lecture Outline

Examination of Construction Materials for Extraction Tanks

- Extraction Tanks
- Extraction Tanks – The Challenge
- Standard Working Methods
- Laboratory Tests
- Field Test
- Recommendations

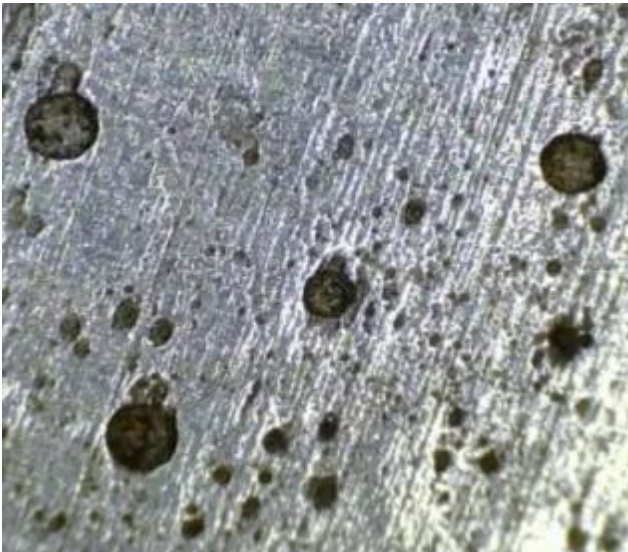


Extraction Tanks for Waste Recycling

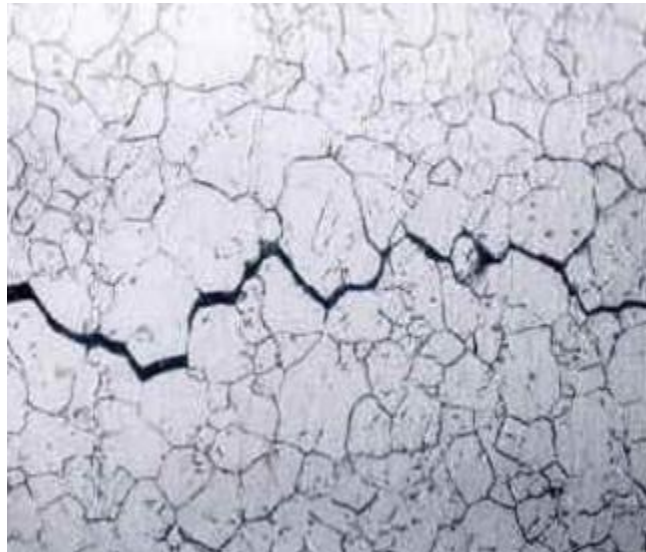
- Development of a process for dissolving the salt from a waste slurry for reuse, promoting circular economy methodology.
- Mixture of salts and insoluble solids.
- Concentrated brine with rich in chloride content.
- Addition of 5% hydrochloric acid.

Extraction Tanks – The Challenge

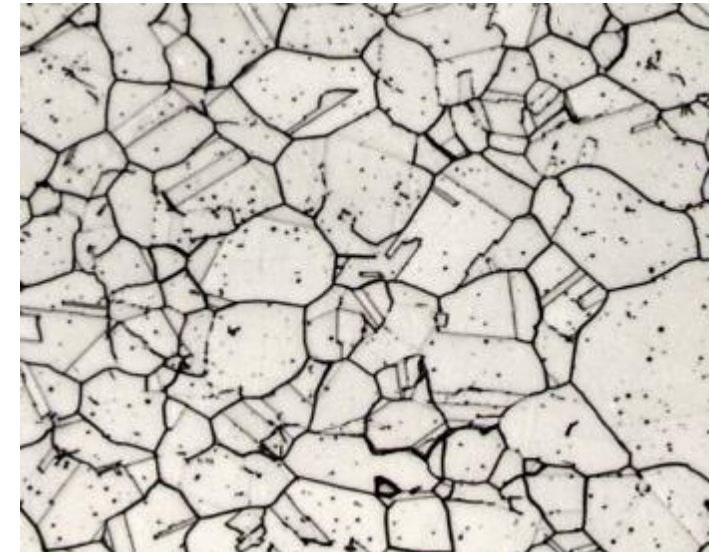
- New tank design - 5000 liters.
- Environment is rich with chloride content.
- Insoluble solids expose the construction materials to abrasion.
- High temperature of 90°C.
- Addition of 5% hydrochloric acid.



Pitting Corrosion



Stress Corrosion Cracking



Intergranular Corrosion

Standard Working Methods

- ASTM D543 – “Standard Practices for Evaluating the Resistance of Plastics to Chemical Reagents”.
- ASTM G31 – “Standard Guide for Laboratory Immersion Corrosion Testing of Metals”.
- ASTM G4 – “Standard Guide for Conducting Corrosion Tests in Field Applications”.
- ASTM D638 – “Standard Test Method for Tensile Properties of Plastics”.
- ASTM D2240 – “Standard Test Method for Rubber Property - Durometer Hardness”.

- Laboratory tests conducted in full immersion and vapor phase exposure.
- Field tests conducted in extraction tanks.
- Construction materials tested:
- Ti Grade 7, Inconel 625, Hastelloy C-276, Ampco 8, PP, PVDF, HDPE and Vipel F085 (FRP).

Examining Construction Materials for Extraction Tanks – Laboratory Gravimetric Tests

Samples tested: Ti Grade 7, Inconel 625, Hastelloy C-276 and Ampco 8.

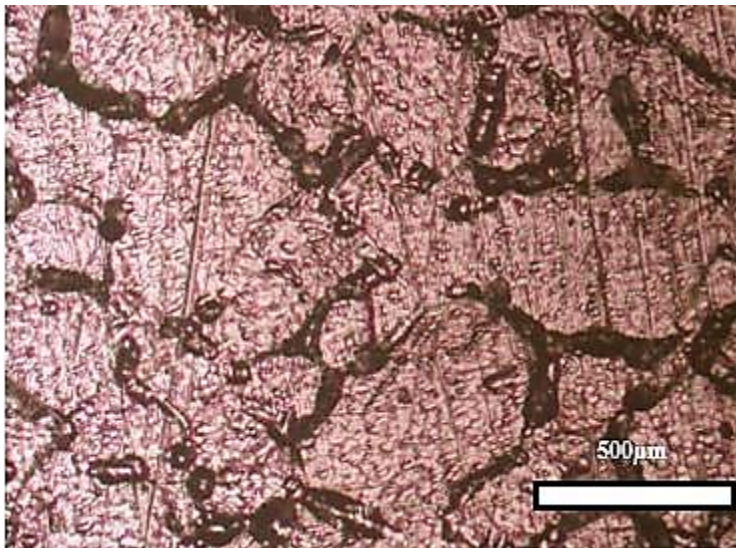
Full immersion and vapor phase exposure at 90°C for one month.

Construction Material	Exposure type	Corrosion rates [mm/year]			
		1st week	2nd week	3rd week	4th week
Ti grade 7	Full Immersion	0.1	0.06	0.05	0.09
Ti grade 7	Vapor Phase	<0.01	<0.01	<0.01	<0.01
Inconel 625	Full Immersion	5.3	5.8	-	-
Inconel 625	Vapor Phase	0.5	0.2	-	-
C-276	Full Immersion	1.0	1.0	-	-
C-276	Vapor Phase	0.5	0.2	-	-
Ampco 8	Full Immersion	6.4	1.4	-	-
Ampco 8	Vapor Phase	6.6	2.3	-	-

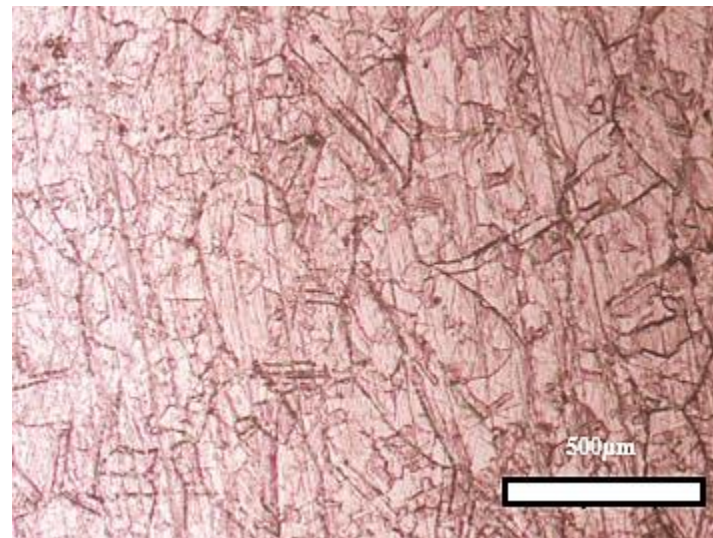
Examining Construction Materials for Extraction Tanks – Laboratory Gravimetric Tests

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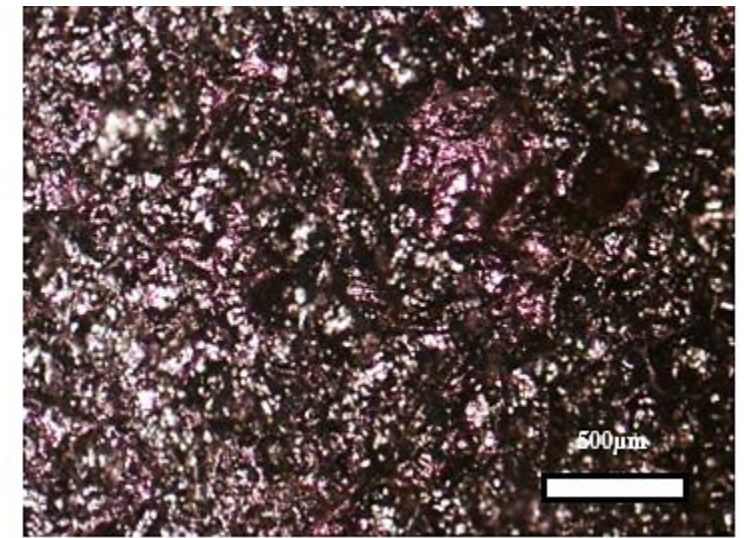
Full immersion and vapor phase exposure at 90°C for one month.



C-276 Full Immersion



Inconel 625 Vapor Phase

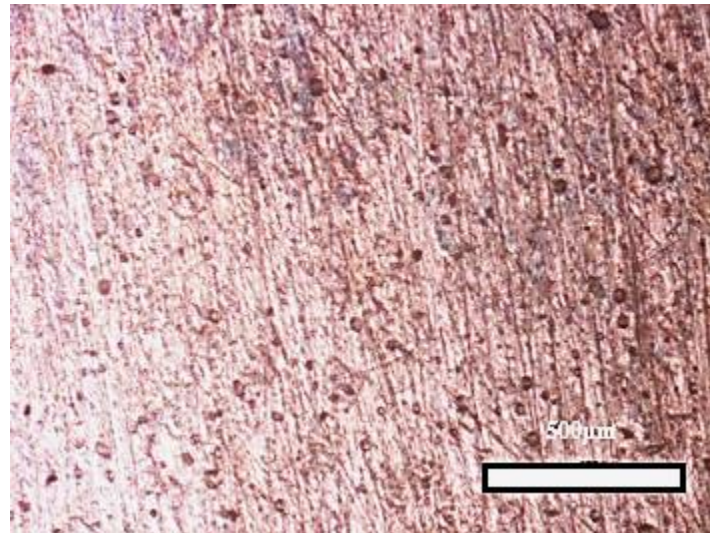


Inconel 625 Full Immersion

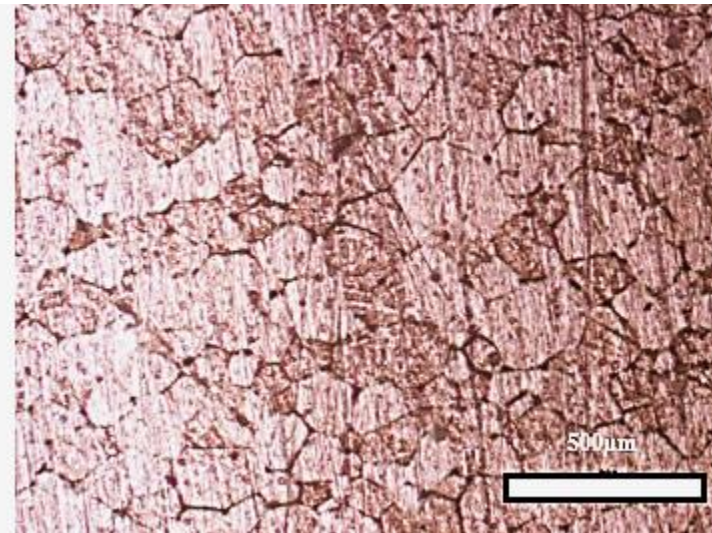
Examining Construction Materials for Extraction Tanks – Laboratory Gravimetric Tests

Samples tested: Ti Grade 7, Inconel 625, Hastelloy C-276 and Ampco 8.

Full immersion and vapor phase exposure at 90°C for one month.



Ti Grade 7 Vapor Phase



Ti Grade 7 Full Immersion

Examining Construction Materials for Extraction Tanks – Laboratory Gravimetric Tests

Samples tested: PP, HDPE, PVDF and FRP F085.

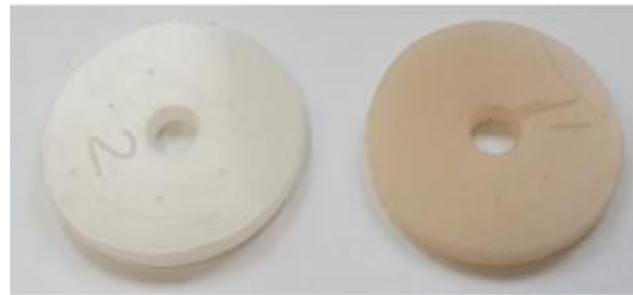
Full immersion at 90°C for one month.

Construction Material	Exposure type	Average weight change [%]
PP	Full Immersion	0.2
PP	Vapor Phase	0.2
HDPE	Full Immersion	<0.1
HDPE	Vapor Phase	<0.1
PVDF	Full Immersion	0.1
PVDF	Vapor Phase	0.1
FRP F085	Full Immersion	0.2
FRP F085	Vapor Phase	0.3

Examining Construction Materials for Extraction Tanks – Laboratory Gravimetric Tests

Samples tested: PP, HDPE, PVDF and FRP F085.

Full immersion at 90°C for one month.



HDPE



FRP F085



PVDF



PP

Examining Construction Materials for Extraction Tanks – Laboratory Gravimetric Tests

Samples tested: PP, HDPE, PVDF and FRP F085.

Full immersion at 90°C for one month.

Construction Material	Type	Hardness Shore D
PP	After Exposure	75
PP	Reference	74
HDPE	After Exposure	66
HDPE	Reference	63
PVDF	After Exposure	79
PVDF	Reference	79
FRP F085	After Exposure	86
FRP F085	Reference	85

Examining Construction Materials for Extraction Tanks – Laboratory Gravimetric Tests

Samples tested: PP, HDPE, PVDF and FRP F085.

Full immersion at 90°C for one month.

Construction Material	Yield Stress [MPa]	Elastic Modulus [MPa]	Maximum Stress [MPa]	Failure Stress [MPa]	Elongation [%]
PP	18	615	32	20	80-113
PP Ref	22	731	37	25	130-345
Difference [%]	-18	-16	-14	-20	
HDPE	10	420	28	28	1700
HDPE Ref	11	296	33	33	>1750
Difference [%]	-9	+42	-15	-15	
PVDF	26	707	53	37	40
PVDF Ref	27	720	55	34	30
Difference [%]	-4	-2	-4	+9	+33

Examining Construction Materials for Extraction Tanks – Field Test

Samples tested: PP, HDPE, PVDF and FRP F085.

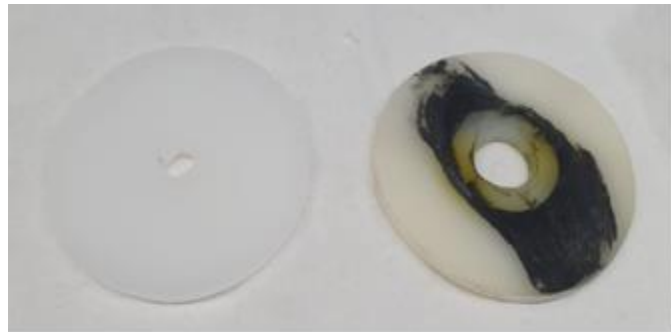
Full immersion at 90°C for 102 days.

Construction Material	Exposure type	Average weight change [%]
PP	Full Immersion	0.3
HDPE	Full Immersion	0.6
PVDF	Full Immersion	<0.1
FRP F085	Full Immersion	<0.1

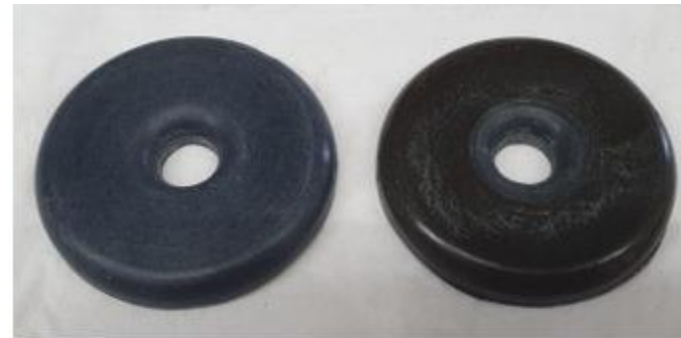
Examining Construction Materials for Extraction Tanks – Field Test

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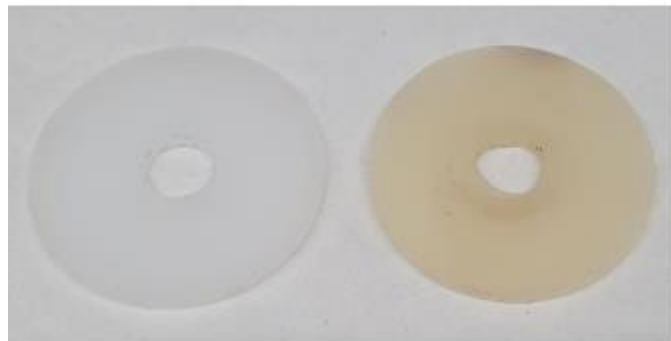
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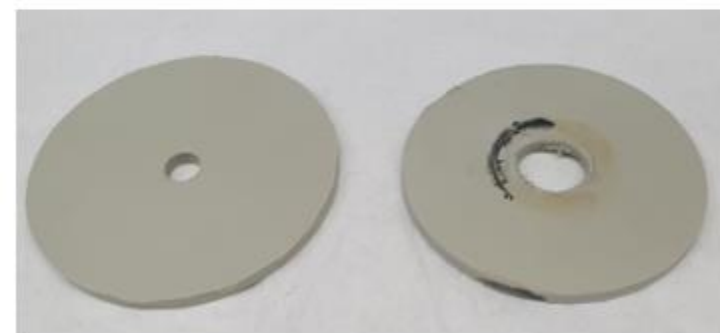
HDPE



FRP F085



PVDF



PP

Examining Construction Materials for Extraction Tanks – Field Test

Samples tested: PP, HDPE, PVDF and FRP F085.

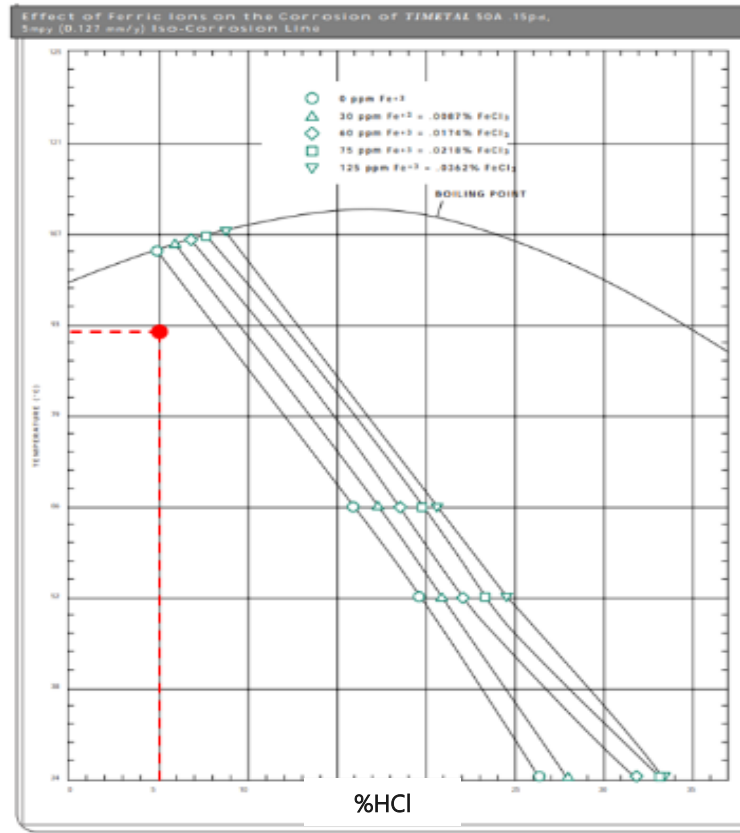
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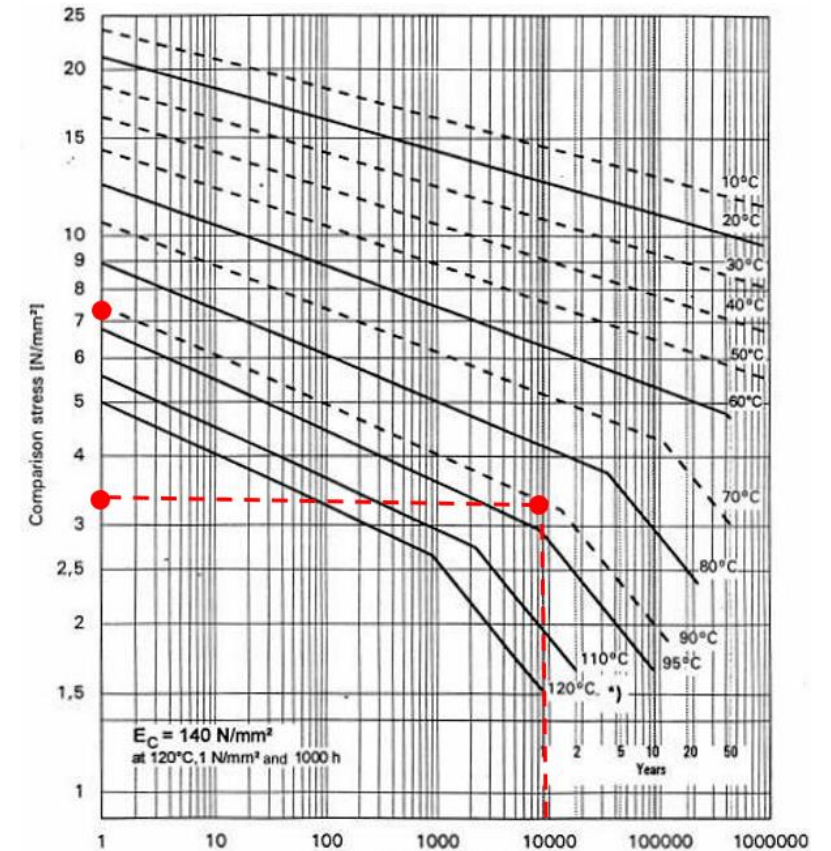
Examining Construction Materials for Extraction Tanks

Conclusion and Recommendations

- PVDF or FRP F085
- HDPE or PP
- Ti Grade 7 - which is only suitable for the baffle or mixer
Needs additional tests.



Ti Grade 7 iso corrosion line 0.1 mm/year



Creep Strength PP Pipes

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