INSTALLATIONERS PÅVERKAN PÅ DRICKSVATTENKVALITET

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Content

- What is drinking water quality?
- How do we test?
- What is acceptable impact?
- Why do materials impact the quality?
- Revision of the EU Drinking Water Directive
- MaiD has transformed to MaiD-NET

Drinking water quality – which main properties?

Hygienic property
Taste and odour
Enhancement of microbial growth (EMG)
Leaching of inorganic substance
Leaching of organic substance

▫ Nordic leaching test method

Drinking water quality – how do we test?

Hygienic property	Metallic	Organic	Cementitious
Taste and odour	Not relevant	EN 1420, EN 1622 and EN 14395-1	EN 14944-1
Enhancement of microbial growth (EMG)	Not relevant	EN 16421	EN 16421
Leaching of inorganic substance	EN 15664, EN 16057, EN 16058, NKB 4[a]	If relevant: The same tests as for organic substances	EN 14944-3
Leaching of organic substance	Not relevant	EN 12873, EN-ISO 8795 and EN 15768	EN 14944-3, EN 15768

[a] Nordic leaching test method

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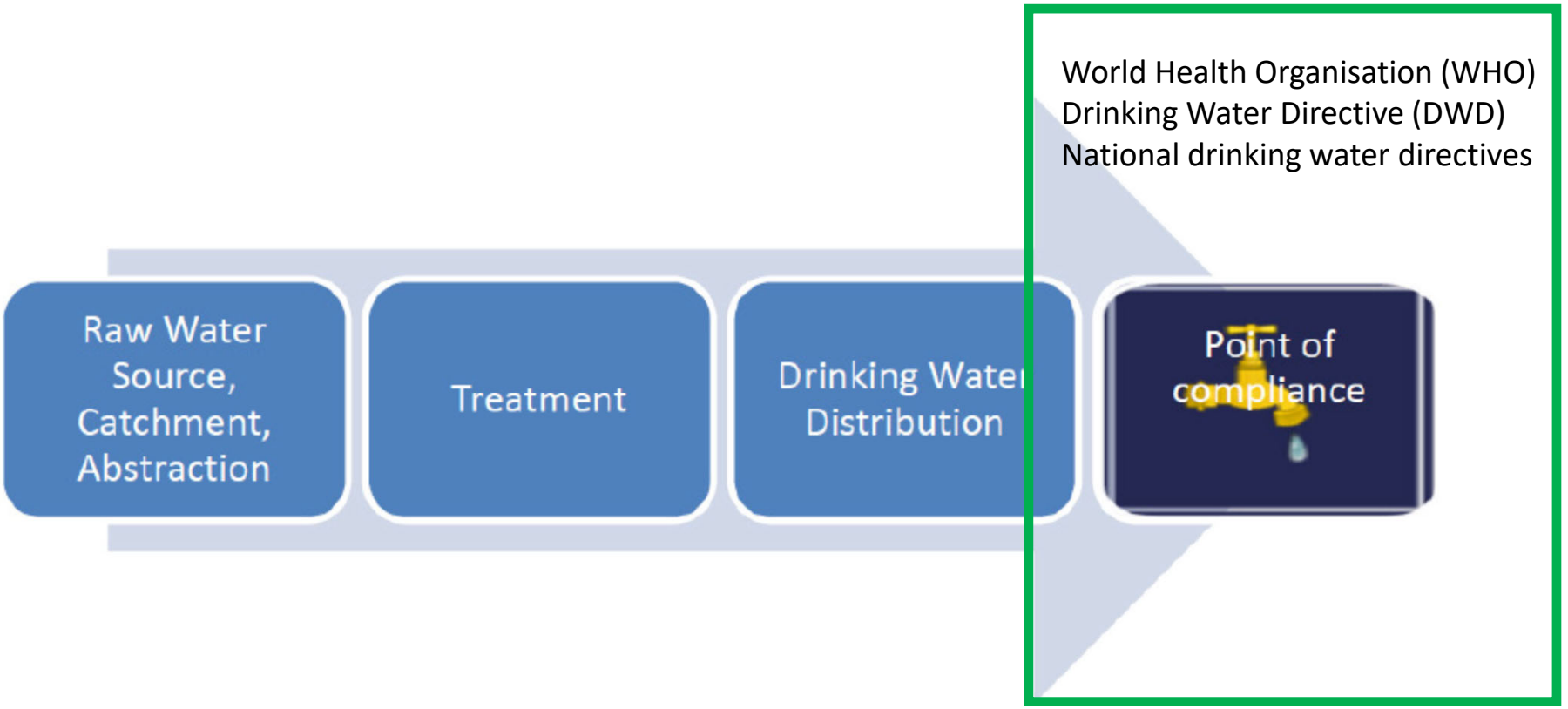
Acceptable impact (health)



Acceptable impact (health) – Criteria for metals

Parameter	WHO Guidelines 2011 µg/L	European DWD µg/L	Norwegian DWD µg/L
As	10	10	10
Cu	2000	2000	1000
Cr	50	50	50
Cd	3	5	5
Hg	6 (inorganic)	1	0.5
Ni	70	20	20
Pb	10	10	10
pH	Not issued	6.5-9.5	6.5-9.5

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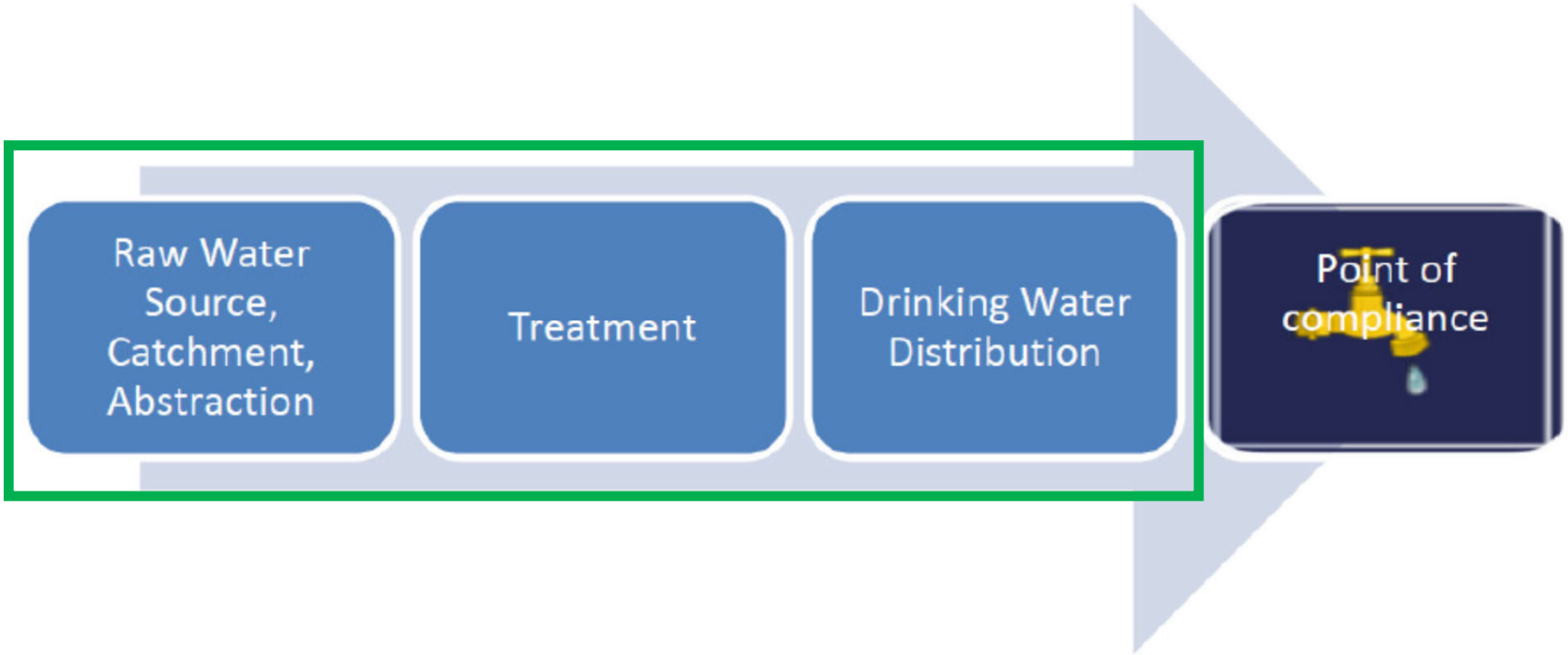
Acceptable impact (health) – WHO

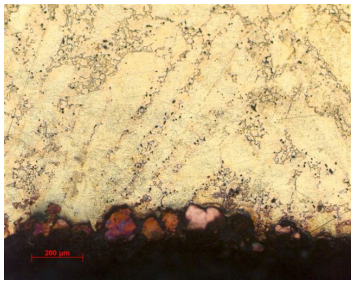
Parameter	WHO Guideline 1958 µg/L	WHO Guideline 1963 (1984) µg/L	WHO Guideline 1993 µg/L	WHO Guideline 2011 µg/L	New proposal from EU?
Pb	100	50	10	10	5
Ni	-	-	20	70	-

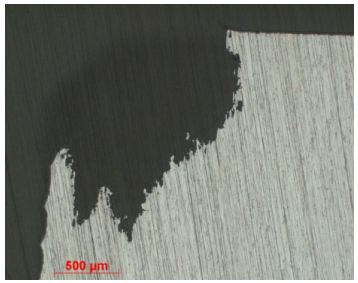
Why do materials impact the drinking water?

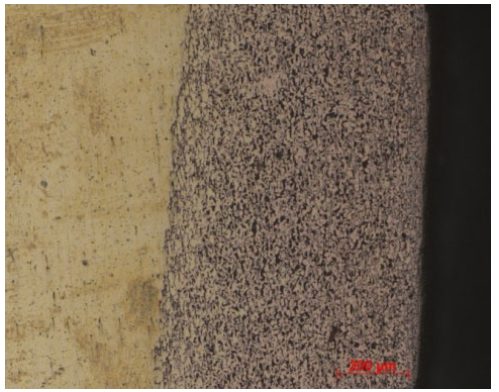


Common corrosion modes in water distribution

- Uniform Corrosion
- Erosion
- Galvanic Corrosion
- Stress Corrosion
- Dezincification







What are the main leaching processes

- **Surface wash-off**
- **Solubility controlled**
- **Diffusion controlled leaching**

What are the fundamental leaching mechanisms

1. **Dissolution/precipitation reactions**
2. **Sorption: Iron and aluminum reactive surfaces**
3. **Solid solution formation (e.g. ettringite)**
4. **Solid Organic Matter interactions (SOM)**
5. **Dissolved Organic Matter reactions (DOM/DOC)**

Corrosion reactions – formation of protective layer

$4Cu + O_2 = 2Cu_2O$

$2Cu + O_2 = 2CuO$

$CuO + H_2O = Cu(OH)_2$

$4CuO + SO_3 + 3H_2O = Cu_4SO_4(OH)_6$

$2CuO + CO_2 + H_2O = Cu_2CO_3(OH)_2$

Corrosion reaction – formation of protective layer

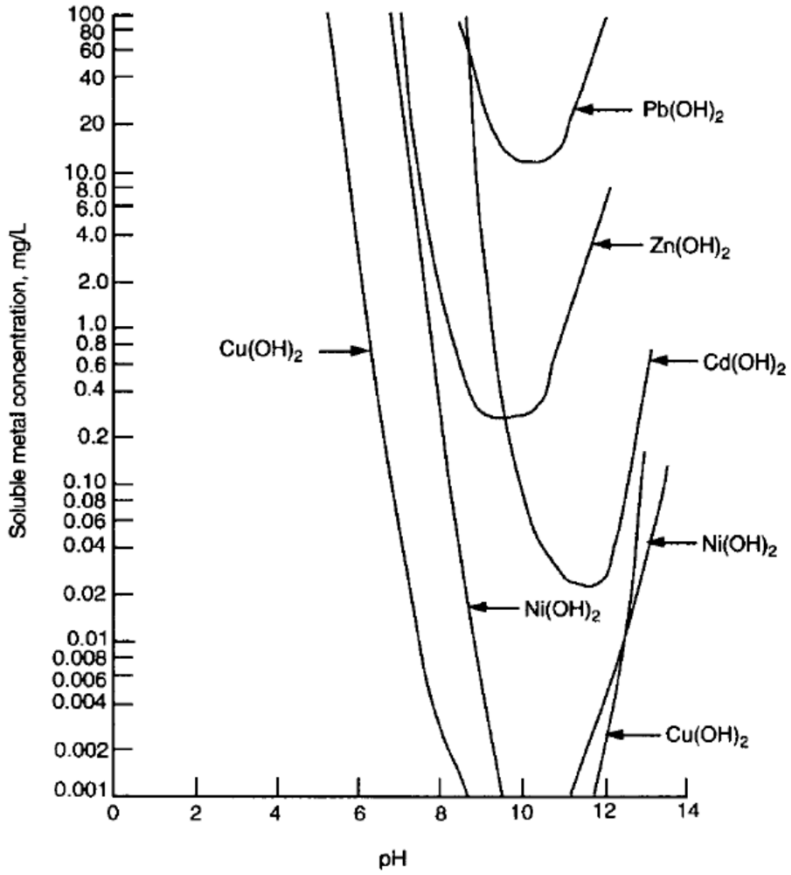
$Pb + O_2 = PbO$

$PbO + H_2O = Pb(OH)_2$

$PbO + CO_2 = PbCO_3$

$3PbO + 2CO_2 + H_2O = Pb_3(CO_3)_2(OH)_2$

Solubility of simple metal hydroxides



pH is one of the master variable for controlling leaching

Other important controlling parameters are:
Alkalinity, salinity, hardness etc.

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MaiD Final report

Material and product innovation through knowledge based standardization in drinking water sector

– Report 3

Nordic Innovation

MaiD Final report

Material and product innovation through knowledge based standardization in drinking water sector – Report 3

A Nordic Innovation project

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DW qualities in Nordic countries – MaiD findings

Country	pH	Alkalinity (mmol/L)	Hardness (mmol/L)	Chlorides (mg/L)	Sulphates (mg/L)	Conductivity (µS/cm)	TOC (mg/L)[a]
Denmark							
-average	7.6	3.93	2.44	49	54	598	-
-std	0.2	2.6	1.2	25	29	229	
Finland							
-average	8.0	0.96	0.61	9	24	175	1.34
-std	0.4	0.5	0.3	8	24	80	0.8
Norway							
-average	7.8	0.61	0.42	7	7	106	2.51
-std	0.3	0.2	0.1	5	6	24	0.9
Sweden							
-average	8.1	1.4	0.81	13	15	226	2.97
-std	0.2	0.7	0.4	11	12	87	0.8

[a] Includes only exact values; in some reports data on TOC were given as < 2 mg/L

11 % of the Nordic population use drinking water of their own wells, and quality of this drinking water is not known

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EN 15664-2 Test waters

Table 5

Test water compositions in the rig test specified in EN 15664-2.

Test water[a]	pH	Alkalinity (mmol/l)	$[Cl^-] + [SO_4^{2-}]$ (mmol/L)	TOC (mg/L)
T1	7.1-7.5	> 5.0	> 3	> 1.5
T2	6.7-7.1	0.5-1.3	No specification	No specification
T3	8.0-8.4	0.7-1.3	No specification	No specification

[a] Oxygen saturation > 70 % for all test waters

Relevance of test waters EN 15664-2 – MaiD findings

Table 6

Evaluation of the compatibility with the test waters in EN 15664-2.

Test water	**Denmark**	**Finland**	**Norway**	**Sweden**
T1	Compatible	Low	Applicable for few lime areas in Norway	Fair for groundwater part
T2	Low	Compatible	Compatible	Low
T3	Low			Compatible (surface water part)

Organic materials MaiD - findings

Table 9
Overview of standards and requirements for organic materials and products.

Assessments for organic materials	Norway	Sweden	Finland	Denmark
General Health requirements in building regulation	Yes	Yes	Yes	Yes
Approval required in regulation	No	No	No	Yes

Assessment of hygienic properties in the approval and certification practice

Product types assessed:	Pipes and hoses	All organic products[b]	Pipes, multilayer pipes, fittings/ connectors	All organic products
Evaluation based on only composition:	No	No	Fittings/connectors	No
Taste and odour assessed for:	Pipes and hoses	All organic products	Pipes	All organic products
Taste and odour, test standard used:[a]	EN standards	EN standards	SFS 2335 Annex A	EN standards
Taste and odour, accepted approvals from other country:	D, NL, DK	D, NL	No	D, NL, SE
Leaching is required:	Yes	Yes	Yes	Yes
Leaching, test standard used[a]:	EN standards	EN standards	EN standards	EN standards
Leaching, accepted approvals from other country:	D, NL, DK	D, NL	No[c]	D, NL, SE
Enhancement of microbial growth required:	Yes	Yes	Under assessment[d]	Yes[e]
Enhancement of microbial growth, test standard used[a]:	EN standards	EN standards	Under assessment[d]	EN standards
Enhancement of microbial growth: Accepted approval from other country	D, NL, DK	D, NL	No	D, NL, SE

[a] Relevant EN standards given in Table 1

[b] Organic components in a composed product with water contact area of < 3 mm² are considered to have low risk and are not reviewed.

[c] Test reports, on which the approval is based, will be studied by type approval body appointed by the Ministry of Environment Finland (at the moment VTT Expert Services). If test methods used and test results correspond to Finnish regulation and type approval decrees, VTT will give type approval without further type testing.

[d] Under assessment by Ministry of Environment in Finland.

[e] Only for filters

4 Member State Common Approach (4MS)

Product type	Name of lists that permit use	Current "working name"	What will the list contain
Metallic	Composition list	Composition list	Alloy compositions
Organic	Positive List	Combined list and Core list	Monomers, additives, aids to polymerization and production
Cementitious	Positive list – Cementitious materials List of Accepted Generic Constituents	PL-CM LAGC	Organic and inorganic substances used for cementitious products Main constituent materials in cementitious products, including their additives and admixtures.

Revision of Drinking Water Directive – Article 10

Minimum requirements for materials that come into contact with drinking water

- New Article 10a that will refer to Positive Lists for all material groups
- Ultimately, only materials and products that are according to this list can be used in contact with drinking water
- Where leaching test is required, EN test methods will be referred to
- Significant part is based on 4MS approach
- Big difference is that the positive lists is becoming European lists
- WHO advise EU to work towards 5 µg/L for Pb

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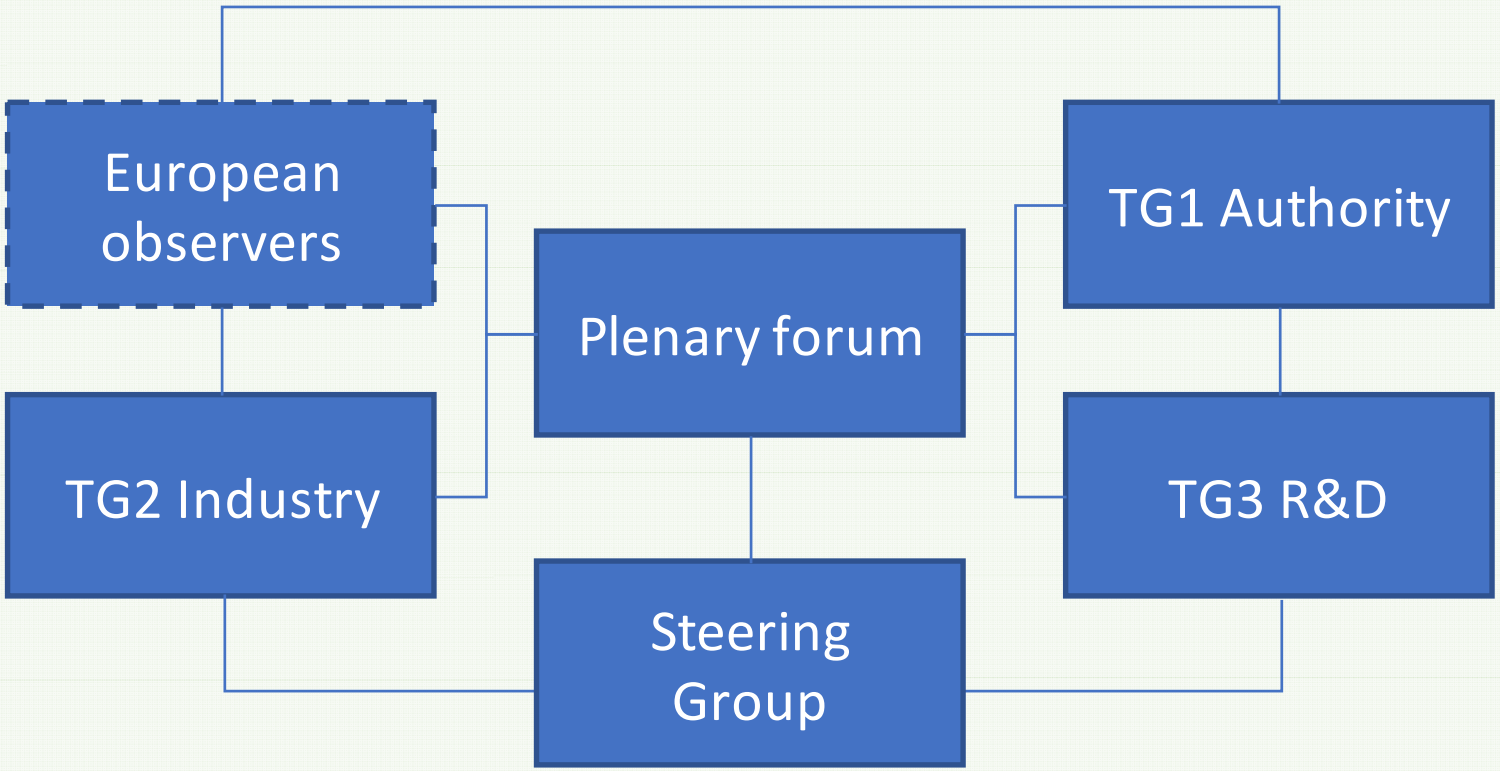

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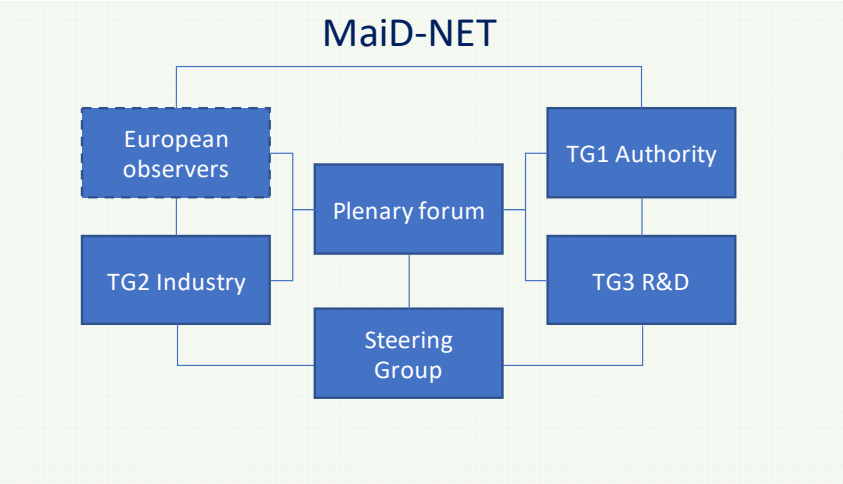
The objective of the network is to share, coordinate and conduct activities that facilitate Nordic input to European harmonisation

Tasks for the first plenary meeting 14. November at Rice in Stockholm



- Define milestones and outputs for MaiD-NET
- Create website
- Share information
- Harmonisation at Nordic level
- MaiD-NET collaboration with European institutions and organisations
- Effects of revision of DWD
- EMG testing and harmonization need to be improved regarding legionella and biofilm
- 4MS feasibility

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Summary

1. Installations impact on drinking water quality depends on water composition, service life time of product, type of installation and user habits

2. The certification and approval situation differ significantly in the Nordic countries today.

3. It is not possible to define only one typical water composition for the Nordic region. Hence, for metallic materials, EN 15664 is beneficial as it uses 3 different water compositions for bulk material leaching properties.

4. When positive lists (substances, material compositions etc.) are developed and used for assessments and approvals with respect to hygienic properties, it is crucial to equally consider the mechanical properties for new MPDW.

5. Revised Article 10 in DWD gives hope towards a more harmonized Europe and a level playing field

Purpose

1. Evaluate the current Nordic approval, acceptance practice and related standards for materials and products in contact with drinking water and identify the mechanism(s) that will increase innovation in the drinking water sector.

2. Identify possible Nordic requirements regarding water quality that needs to be addressed in existing test methods and standards to ensure at least the present level of protection regarding health and safety.

3. Evaluate the applicability of the 4MS acceptance procedure and related standards to Nordic conditions.

4. Give recommendations on how the laboratory capacity in the Nordic countries for testing and acceptance of materials in contact with drinking water based on relevant identified standards can be strengthened, in order to provide the services expected from the Nordic industry.

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WP3 DW survey

Data from 109 waterworks