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IMPLEMENTATION of the TEST-BATTERY APPROACH into ROUTINE EFFLUENT CONTROL in LITHUANIA

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Recently, HELCOM, expressing a concern on the status of the Baltic Sea, has initiated several international programmes such as Cohiba, BaltHaz, etc., particularly targeted to promote the usage of Whole Effluent Assessment (WEA) methods in routine regulation. Contrary to the control of individual substances, which is based on knowledge of a single concentration, municipal and industrial effluents can be regulated directly on basis of harmful effects that occur in testing organisms. Various countries use laboratory toxicity tests to monitor effluent discharges into surface waters in various degrees. For example, acute and chronic toxicity tests are used in the USA, Sweden and Canada, whereas acute tests are used in several European countries. Up to date, the majority of countries provide chemical-based effluent controls, however, the progressive increase of chemicals under control and difficulties in measuring them make individual-substance approach problematic. In some countries, toxicity data are included for taxation purposes, in parallel to chemical-based taxation. For example, toxicity data obtained from *D. magna* acute and fish embryos tests used in France and Germany, respectively.

In 2011, the Ministry of Environment of Lithuania put forward a national programme with the aim to elaborate a system of effluent control by implementing toxicity tests. The outcome of this programme includes appearance of necessary environmental juristic documents and/or their updates, selection of test-batteries, selection of the cumulative index for toxicity evaluation and performance of initial stage of effluent inventory monitoring. The evaluation of potential harm for aquatic environment is limited to the application of end-of-pipe principle, the assessment of effluent by acute and/or chronic toxicity test-batteries as well as effluent- and stream flow rates. The polluters will be grouped according to the criteria of the type of economical activity and discharge rate. During one-year inventory period, respective test-battery(ies) will be applied and the most sensitive test(s) will be prescribed for routine effluent control. In this study, a system for municipal and industrial effluents control as well as simultaneous steps of its implementation into routine will be overviewed.

Nowadays effluent control in LITHUANIA

- Regulation of effluent discharge into surface waters stands on chemical approach
- Taxes for pollution grow proportionaly to the discharged ammount of toxic substancies that fall under regulation
- Emition of toxic substancies into waterbodies is unlimited untill aftereffects are evident
- Deeppeness of pollution aftereffects is justified according to biotic index and visible injury to fish

Main WEA implementation principles

- **Toxicity control is assigned to major polluters:** Effluent dischargers (pipes) are divided into 3 groups with variuos level of toxicity control, i.e., (1) without toxicity control, (2) with acute toxicity control and (3) with acute & chronic toxicity control.
- **Test-battery approach:** Test-battery is applied to estimate effluent toxicity during the inventory period, while most sensitive test(s) is(are) applied during routine monitoring. Most Sensitive Test index (MST) is used as a measure of ecotoxicity.
- **Toxic load** (product of ecotoxicity and amount of discharged effluent) is supposed to be used for taxation.

Main Normative Legal Documents to be introduced into Environmental Legislation

- Ordinance on Requirements for the Effluent Ecotoxicity
  Biotests, batteries, ecotoxicity indices, rating system etc
- Effluent Discharge Regulations (changes)
  Max allowable ecotoxicity of effluents (1 TU50/1TU25)
- Regulations of Environmental Monitoring of Economic Entities (changes)
  Frequency of WW ecotoxicity measurements for the 2nd & 3rd group of dischargers

Criteria to atribute effluent discharger to a certain group

Criterion → **ENVIRONMENTAL HAZARDOUSNESS OF ECONOMIC ACTIVITY** (points) + **EFFLUENT DISCHARGE RATE** (points)

Effluent discharger is attributed to the certain group according to the summ of points:

< 51	→	I group	→ **chemical control**
≥ 51 & < 80	→	II group	→ **acute toxicity control**
≥ 80	→	III group	→ **acute & chronic toxicity control**

Biotest batteries

Acute toxicity

Unicellular green algae growth inhibition test. LST EN ISO 8692:2012. „Water quality – Fresh water algal growth inhibition test with unicellular green algae (ISO 8692:2012)".

Shrimp lethality test. ISO 14380:2011. „Water quality – Determination of the acute toxicity to *Thamnocephalus platyurus* (Crustacea, Anostraca)".

Bacteria bioluminescence inhibition test. LST EN ISO 11348-3:2009. „Water quality – Determination of the inhibitory effect of water samples on the light emission of *Vibrio fischeri* (Luminescent bacteria test) - Part 3: Method using freezedried bacteria (ISO 11348-3:2007)".

Chronic toxicity

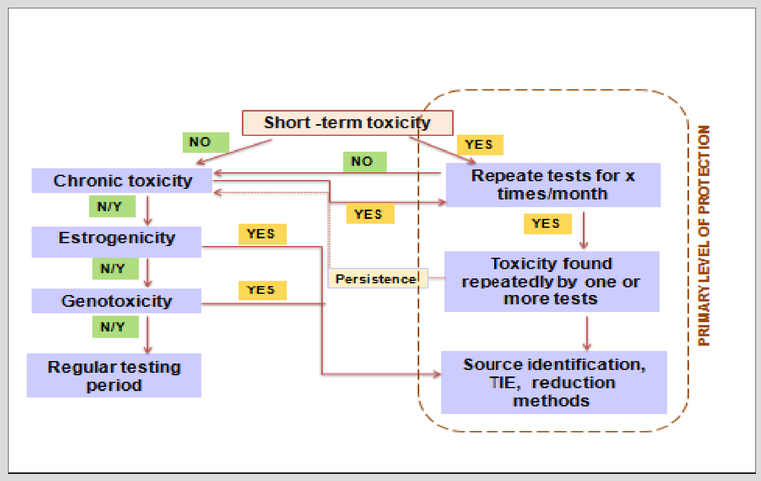
Duckweed growth inhibition test. LST EN ISO 20079:2006 „Water quality – Determination of the toxic effect of water constituents and waste water on duckweed (*Lemna minor*) – Duckweed growth inhibition test (ISO 20079:2005)".

Daphnia reproduction test. ISO 20665:2008 „Water quality – Determination of chronic toxicity to *Ceriodaphnia dubia*".

Zebra fish embryos and larvae toxicity test. ISO 12890:1999(E) „Water quality – Determination of toxicity to embryos and larvae of freshwater fish – Semi-static method".

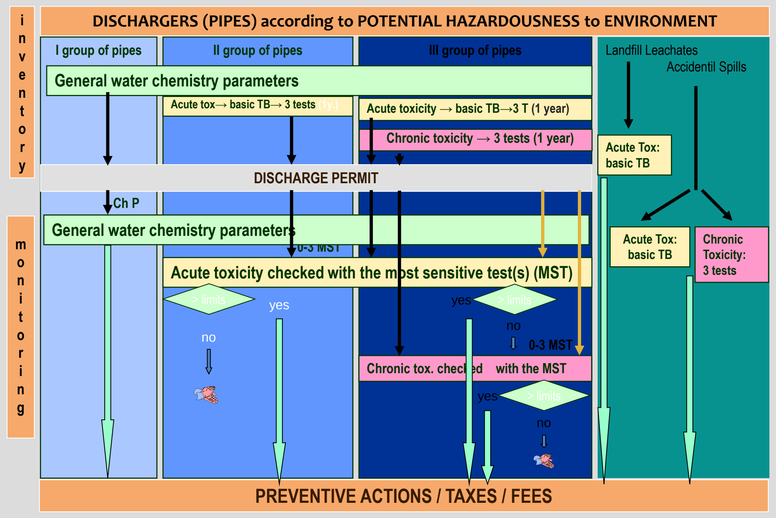
Introduction of biological treatment facilities and drastic change of industry during last 20 years significantrly reduced toxicity of wastewaters in Lithuania. Permanent efluent toxicity was replaced by temporal toxicity. Avarage of toxicity detection frequency in effluent samples in 1998-2010 was **>30** percent, while effluent screening conducted in 2013-year revealed only **15** percent freqency of toxicity detection.

HELCOM APPROACH



To our knowledge not established in full extent

PROPOSED EFFLUENT ECOTOXICITY CONTROL SCHEME (Lithuania)



REAL-LIFE DATA – LITHUANIA (2010)

831 pipe discharging effluents into surface waters

Criterion (1)

Environmental Hazardousness Class		The number of effluent pipes
0	(0)	204
1	(20)	37
2	(40)	586
3	(50)	4

Criterion (2)

Flow rate class, m³ per year (points)		The number of effluent pipes
< 36 500	(0)	633
≥ 36 500	(20)	143
≥ 1 000 000	(30)	44
≥ 5 000 000	(40)	6
≥ 10 000 000	(50)	5

Criteria (1) + (2) →

Discharger Group	The number of pipes
1	713
2	110
3	8

REAL-LIFE DATA – LITHUANIA (2013)

Acute Toxicity Data of 23 Pipe Discharging Effluents into Surface waters

No.	Discharger	Flow, m³/d	Acute toxicity, TU: Algae	Shrimps	Bacteria	Group
1.	"Vilnaus vandenys"	95000	0.0	0.0	0.0	III*
2.	"Dzūkijos vandenys" (Alytaus NVĮ)	7908	0.0	0.4	0.0	II
3.	"Lazdijų vanduo" (Veisiejų NVĮ)	53	0.0	0.0	0.0	I
4.	"Birštono vandentiekis"	2327	0.0	0.0	0.0	II
5.	"Sūduvos vandenys"	8494	0.0	0.0	0.0	II
6.	"A.Rinkevičiaus VĮ " (Šakių r.)	175	0.0	0.0	0.0	II
7.	Pravieniškių AK VĮ (Kaišiadorių r.)	1976	0.0	0.0	0.0	II
8.	"Achema" (Jonavos r.)	6000	0.0	0.0	0.0	III
9.	"Lifosa" (Kėdainių r.)	2142	0.0	0.0	0.0	III
10.	Panevėžio m. VĮ	22014	0.0	0.0	0.0	III
11.	UAB "Šiaulių vandenys"	17200	0.0	0.0	0.0	III
12.	Mažeikių m. VĮ	7858	0.0	0.0	0.0	II
13.	Nemenčinės m. VĮ	760	0.0	2.8	0.0	II
14.	Šalčininkų m. VĮ	1109	0.0	0.0	0.0	II
15.	"Utenos vandenys"	9240	0.6	0.0	0.0	II
16.	"Šilutės vandenys"	6500	0.0	0.0	0.0	II
17.	Klaipėdos kartonas	2000	0.8	0.0	1.7	II
18.	AB "Klaipėdos vanduo"	61993	0.0	0.0	0.0	III
19.	UAB "Palangos vandenys"	11000	0.0	0.0	0.0	II
20.	Kauno m. VĮ	54293	0.0	0.0	0.0	III
21.	Ariogalos m. VĮ	425	0.7	3.7	0.0	II
22.	Raseinių m. VĮ	1018	0.0	0.0	0.0	II
23.	Šimkaičių kaimo nuotekos	7	0.0	1.4	0.0	I

* Effluents of III[rd] group were not toxic to Lemna (chronic toxicity test)