



METAL RECOVERY WITH CH COLLECTOR SOLUTION

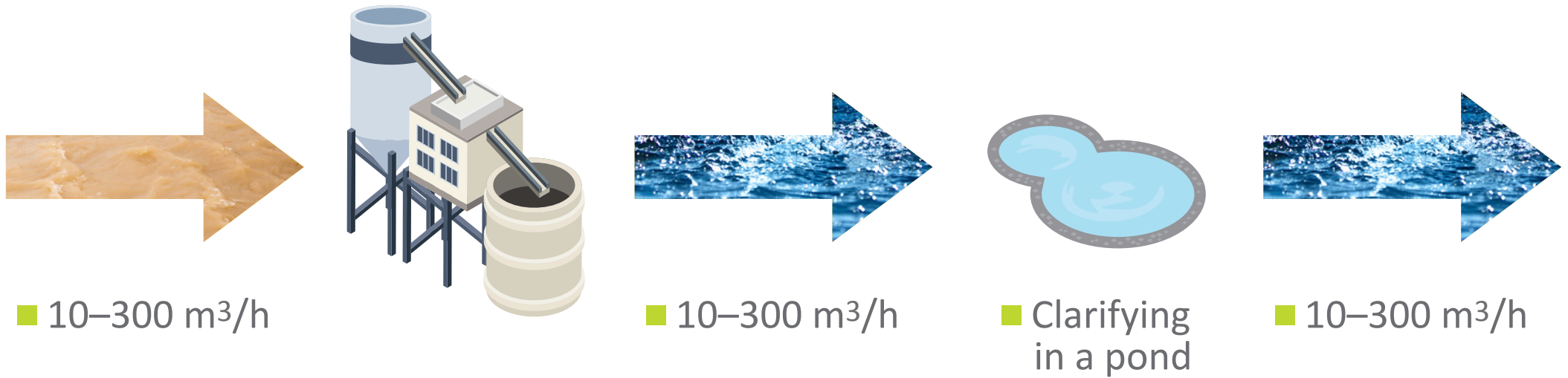


CH COLLECTOR - SOLUTIONS

UNIQUE METAL RECOVERY FROM WATERS, HIGHLY SELECTIVE ON:

- **Basic metals;** Antimony, Copper, Lead, Mercury, Nickel and Zinc
- **Rare Earth Elements ("REE");** Scandium, Yttrium
- **Precious Metals;** Palladium, Platinum
- **Radioactive Metals;** Molybdenum, Thorium and Uranium
- Non-toxic and environmental friendly method
- Globally patented
- Easy installation solutions to existing processes

GENERAL INFO - CHEMEC MINING ACTIVITIES



- Efficient
- Cost-effective
- Mobile
- Fast installation

SUMMARY OF TOXICITY

1) Acute toxicity in rat:

The purpose of this study was to investigate the acute toxicity of the test item KUC-24010, according to the OECD Fixed Dose procedure after single oral (p.o.) dose in the rat.

2) AMES Test:

The bacteria reversed mutation assay (Ames Test) was used to evaluate the mutagenic properties of the test item with five strain. The bacteria reversed mutation assay (Ames Test) was used to evaluate the mutagenic properties of the test item. Bacterial Reverse Mutation Test was conducted using *Salmonella typhimurium* tester strains viz. TA97a, TA 98, TA 100, TA 1535 and TA 102. This study was performed in full compliance with the OECD guidelines for testing of chemicals section 4, *Salmonella typhimurium* Reverse Mutation Assay, Test No.471 revised in December 1997.

3) Ecotoxicology

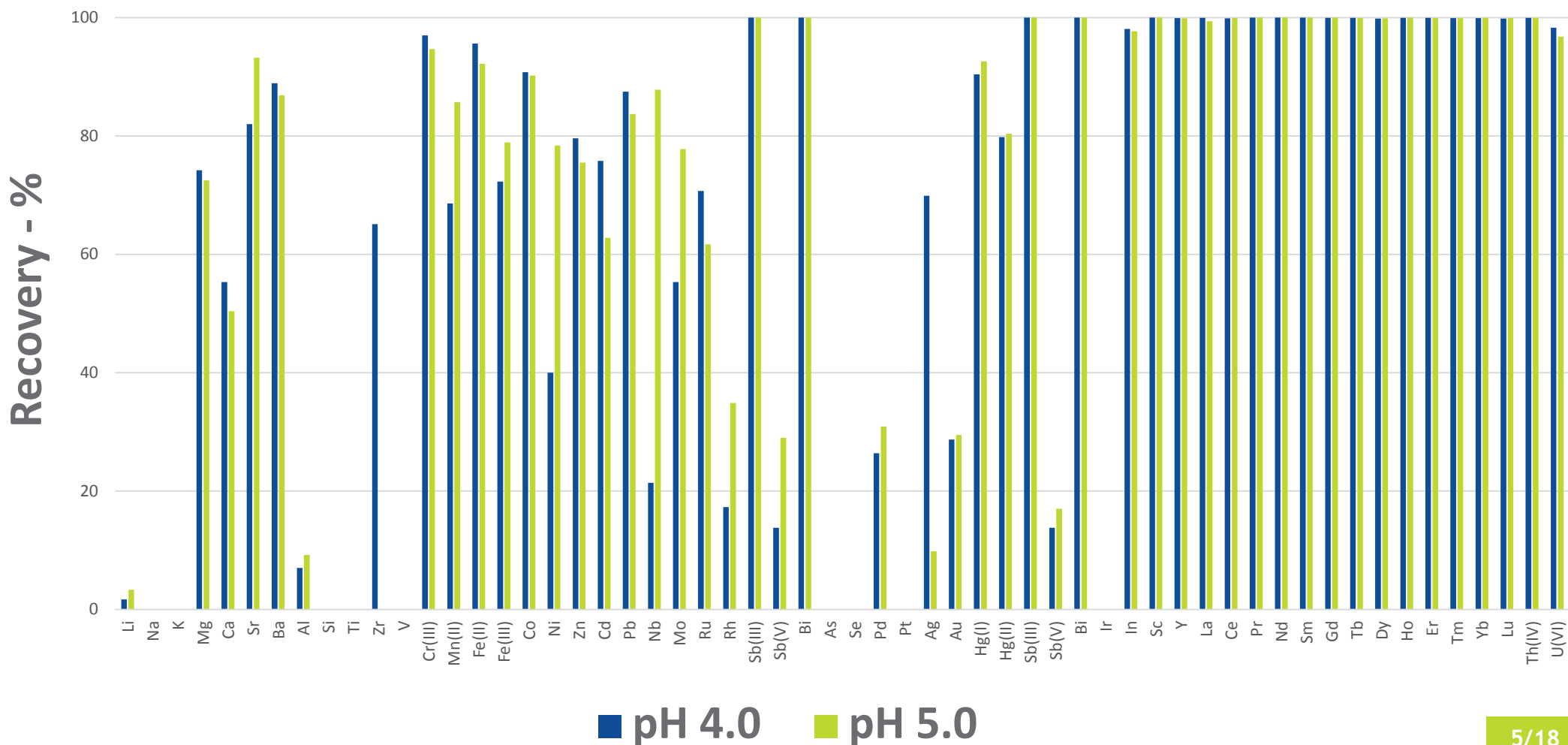
(a) Acute toxicity for *D. magna*: The purpose of acute toxicity test for *D. magna* test (SFS-EN ISO 6341; 1996) was to determine the median effective concentration for immobilization (EC50) of the test item to *D. magna* for 24 and 48 h. Test item (405,4 mg) was added to 1000 mL of reverse osmosis water. Suspension pH was 6,04 and oxygen conc. 8,7 mg/L. Lighting: 16/8 h (l/d), 1500 Lux, temp. 22 ± 1 °C. Suspension was diluted to water (3 parallel/conc., pH 7,7, cond. 49,6 mS/m) and *D. magna* (5/test tube, age <24 h) exposed by the test item.

Results

According to the present study results, the test item KUC-24010 has not observed any toxic effects in acute toxicity study in rat, Ames-test or ecotoxicological studies.

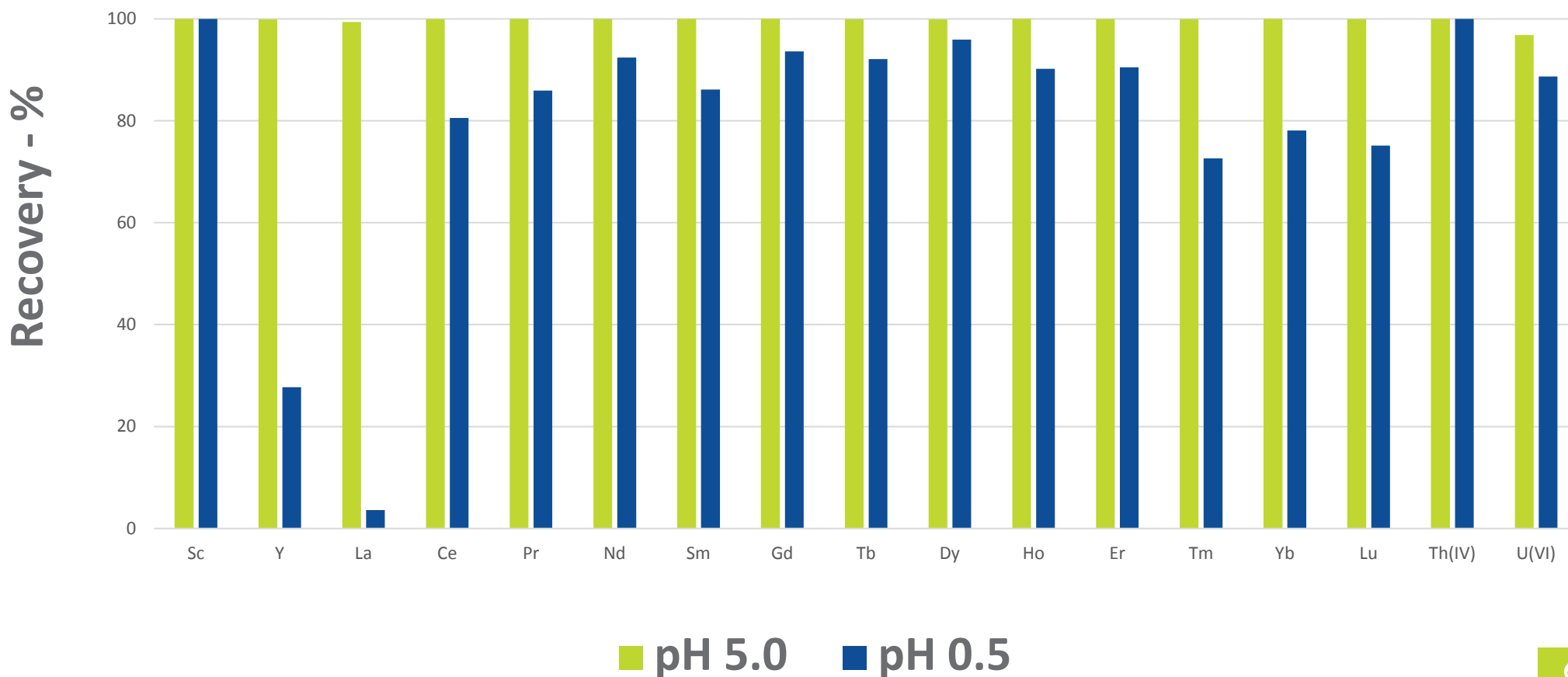
RECOVERY OF 50 METALS WITH CH COLLECTOR

■ Selectivity on various Metal ions at different pH



RECOVERY OF 50 METALS WITH CH COLLECTOR

■ Selectivity on Rare Earth Elements (REE), Uranium & Thorium, at different pH



CH COLLECTOR - RECOVERY

BASIC METALS

HIGH RECOVERY

Ca, Mg, Ba, Ga, In, Mo, Mn, Fe,
Ru, Os, Co, Sn, Sr, Zr, Cr, Ni, Cu,
Zn, Cd, Hg, Pb, Sb, U

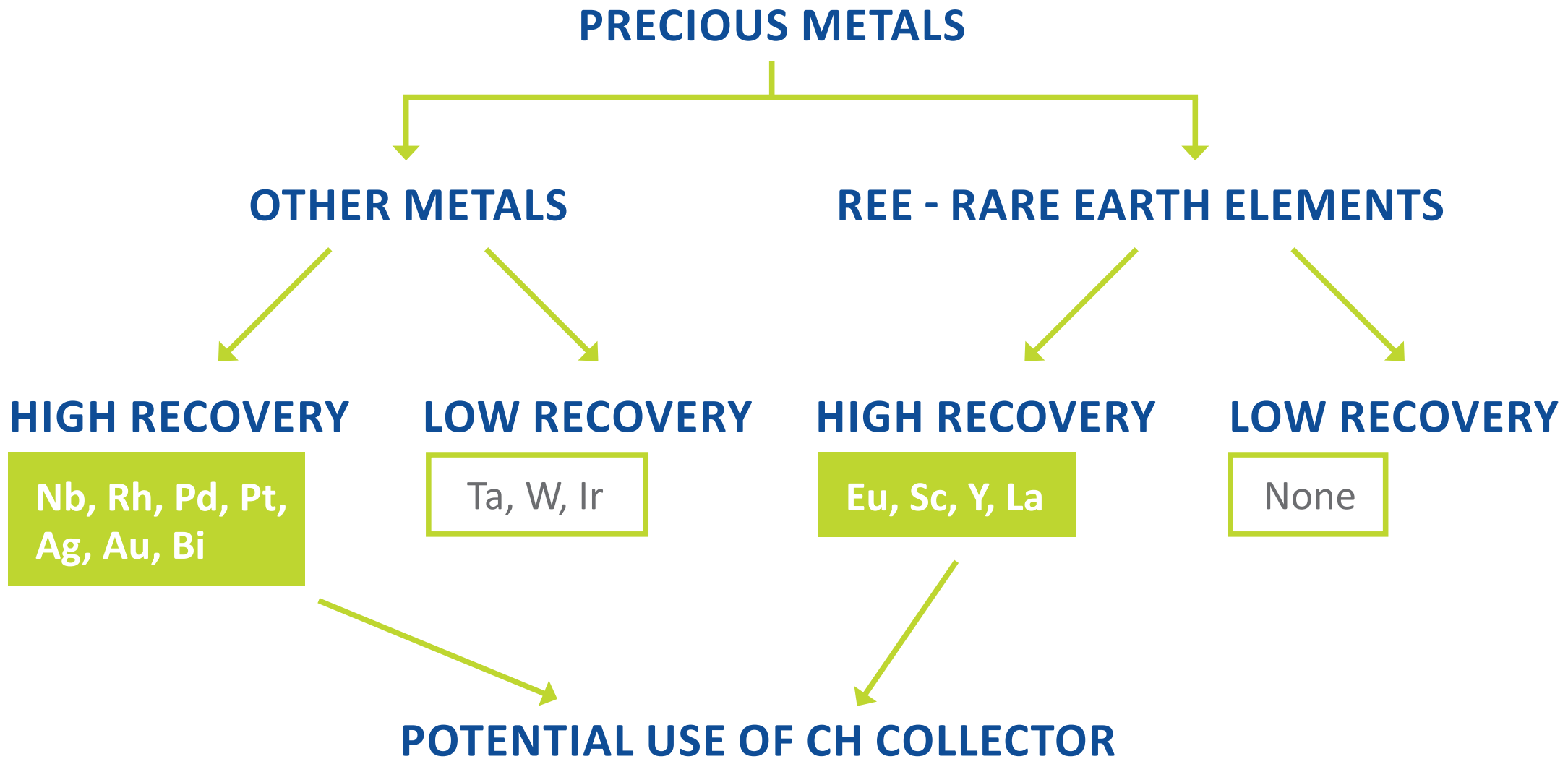
LOW RECOVERY

Li, Na, K, Si, Se, V,
As, Al

POTENTIAL USE OF CH COLLECTOR

Sr, Zr, Cr, Ni, Cu, Zn, Cd, Hg, Pb, Sb, U

CH COLLECTOR - RECOVERY

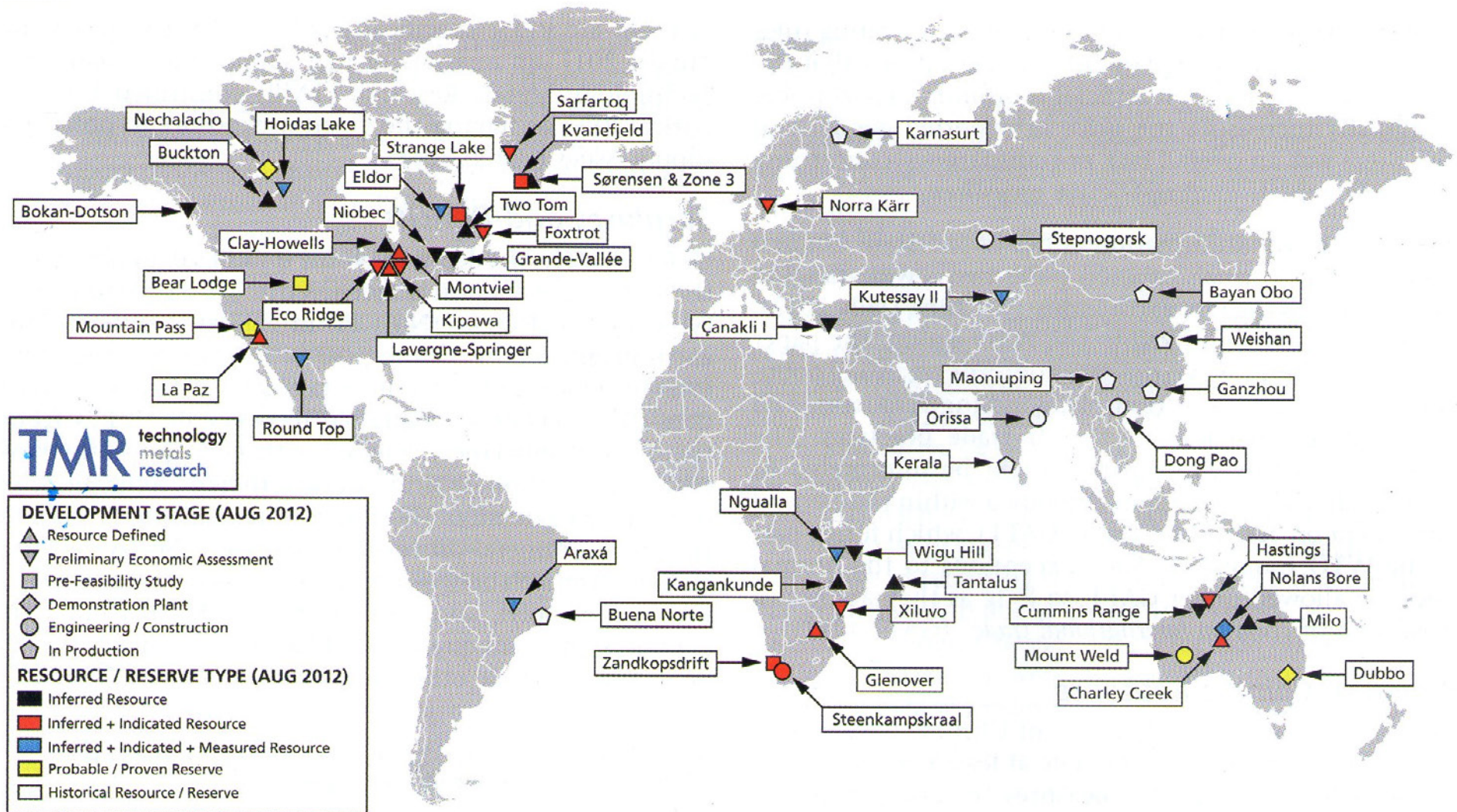


REE METALS IN EUROPE



- Finland has been active in mineral strategy work in EU because of increased level of mining industry.
- Rare Earth Elements and Yttrium are Critical Raw Materials (CRM) which are essential for modern technologies.
- REE-metals and Yttrium are critical resources in EU and development of the production is needed through active cooperation between EU countries.
- In 2011, global demand was 105 kt of REY oxides and is expected to grow to 160 kt in 2016 (Hatch, 2012).

REE RESOURCES GLOBALLY



FROM LABORATORY - TO FULL SCALE TRIALS

SCANDIUM

Laboratory Scale trials

2009-2013

■ Kuopio University

2014

■ Oulu University

2015

■ Univ. Of Barcelona (ESP)

■ Univ. Of Huelva (ESP)

Result

■ 91 % recovery (41 ppb >> 4ppb)

Pilot Scale trials

2014-2015

■ University Of Oulu (2years)



FROM LABORATORY - TO FULL SCALE TRIALS

SCANDIUM

Q4/2015

- Full Scale trials
 - Rio Odiel river in Spain under following conditions
 - Water flow: 50 – 90 m³/h, very challenging river water
 - pH 1,6 - 2,5
 - SO₄ content 16,1g/l, Fe content 2,2 g/l
 - Almost all REE metals present in the water (not Hf, Nb and Ta)
 - » Able collect selectively Sc, all other REE levels stayed same
 - 82 % recovery (230 ppb » 40 ppb)

FROM LABORATORY - TO FULL SCALE TRIALS

NICKEL, YTTRIUM, URANIUM, ANTIMONY

- Full Scale trials performed at:
 - 3 functioning mines in Finland

Q1/2014

a) Magnesiumsilicate Mine + Nickel




Q2/2014

b) Yttrium, Uranium

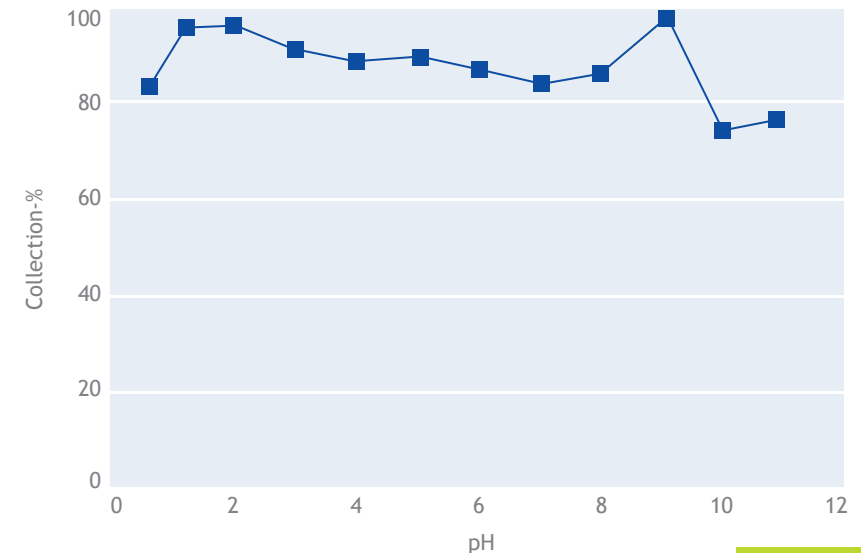
Q3/2014

c) Antimony

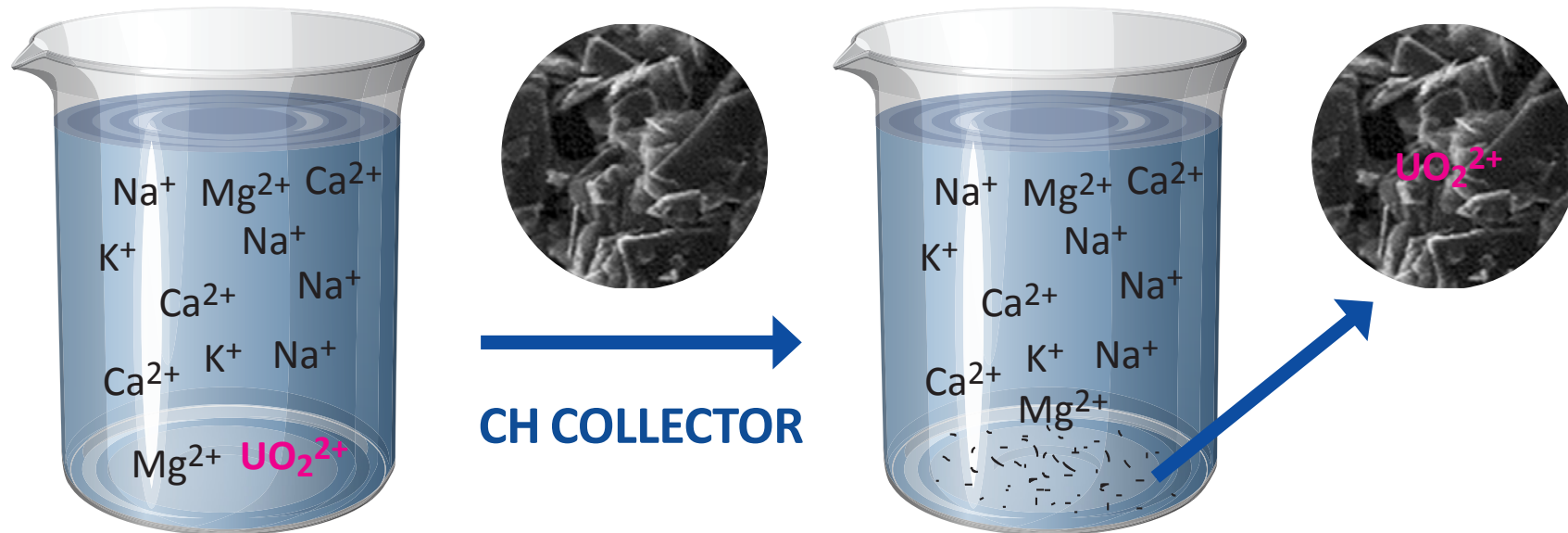
CH COLLECTOR - URANIUM

- 
 Uranium recovery of 97 % achieved in 100 m³/h pilot scale production.
- 
 Over 97 % recovery rate in laboratory scale for Th and U.
- 
 Selective and efficient Uranium removal over broad pH range in the presence of other metal ions (e.g. 25 000 x Na⁺, 100 x Mg²⁺, 100 x Ca²⁺)

Company	Removal efficiency [%]	
	Th	U
Mine O (pilot)	-	97,0
Mine T	99,9	100
Mine K	-	100
Factory H	-	99,1
Mine L	-	100



SELECTIVE METHOD - URANIUM



CH COLLECTOR - STEPS TO SUCCESS

- Consultative planning work of process water and waste water treatment
- Search for the most cost-efficient water treatment system in laboratory scale
- Pilot scale trials with selected water treatment systems
- Tailor-made industrial solution for water treatment
- Long term professional technical water treatment support



CHEMEC AROUND THE GLOBE

HEAD OFFICE

- Finland

RESEARCH CENTER

- Finland

PRODUCTION PLANTS

- Finland
- Germany
- USA

OFFICES

- Finland
- Germany
- USA
- Singapore
- Sweden
- United Kingdom
- Belgium
- India

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