# FORUM BOOK

# 14th International HCH and Pesticides





21-24 February 2023

Zaragoza, Spain















# 14th INTERNATIONAL HCH & PESTICIDES FORUM

#### Theme:

How the European Union is managing the Legacy of Lindane and HCH waste.
What are the "Lessons learned" and what is the "Way forward"

The 14th Forum discusses the State of the art on POPs elimination 31 years after the first Forum in Zwolle, The Netherlands

21-24 February 2023 Zaragoza, Spain

#### **Editor**

Kateryna Okhotnyk, International HCH and Pesticides Association, Holte, Denmark

#### **Support and Quality control**

John Vijgen, International HCH and Pesticides Association, Holte, Denmark

#### Design

Kateryna Okhotnyk Andrea Vijgen Stroebaek Jeppe Daugbjerg Rasmussen Alicia Sánchez-Valverde Susana Urbez

#### **Disclaimer**

The 14<sup>th</sup> International HCH & Pesticides Forum has been supported by the EU LIFE SURFING project, and several other sponsors. The contents of this publication are the sole responsibility of the authors and coauthors and can in no way be taken to reflect the views of the European Union, the Aragon Government, or other sponsors. Parts of the contents of this publication can be used under the condition that reference is given to the title of this publication, year of publishing the 14<sup>th</sup> Forum Website <a href="http://www.hchforum.com/">http://www.hchforum.com/</a> and the library of IHPA.

All Forum books can be found in the library of IHPA at http://www.ihpa.info/resources/library/

#### **ACKNOWLEDGEMENT**

We like to thank all sponsors, who have financially supported the Forum. Without their support it would not have been possible to organize the 14th Forum.

We like to thank all participants present in Zaragoza and those that have been participating online for their engagement and active participation.

Thanks to all the chairs for guiding the sessions.

Special thanks to those coordinators/chairs that have prepared over a long time Special sessions with invited speakers:

Roland Weber & Dietmar Müller Grabherr: Session EMERGING POLLUTANTS. PFAS.

Walter Lichtensteiger & Margret Schlumpf: Session TOXICOLOGY: NEW APPROACHES TO TESTING OF CHEMICALS BASED ON OMICS AND EPIDEMIOLOGY: EXAMPLE DEVELOPMENTAL NEUROTOXICITY.

Dirk Jan Hoogendoorn & Ed Verhamme: Session PCB MANAGEMENT.

Stephan Robinson: Session LIFECYCLE MANAGEMENT OF PESTICIDES AND DISPOSAL IN CENTRAL ASIA COUNTRIES AND TÜRKIYE.

Special thanks to the Government of Aragon and SARGA for their great hospitality as hosts for the Forum.

Special thanks to Alicia Sánchez-Valverde and Susana Úrbez of SARGA for their tireless efforts to get all things organized for the Forum in Zaragoza.

Special thanks to Elena Cano and Jesus Fernandez for their support and advice for the finalization of the program for the Forum sessions.

Special collaboration of SARGA for the organization of the forum: as a sustainable event by Teresa Arrufat and Mar Blasco; streaming and on-event in English and Spanish by the IT Department (Oscar Pueyo, David Barrera, Fernando García); logistical support from Alberto Peiró, Nuria Loma, Ana Ruiz, Carlos Ayala, Marcos Ventura and Blanca Martínez. Support on the excursion from the Bailin staff (Pilar Gonzalvo, Vicente Cuen, Fernando Pardo, Pedro Grasa, German Lobato, Jorge del Tiempo, Carlos Lobato, Cristina Clavería, Emilio Iriarte, Carlos Herranz, Sergio Lasaosa and Antonio Salvatierra.

Photographer and video report: Fabián Simón.

Sustainable Event Certification: Control Union.

Finally, thanks to all those communal, regional, national politicians and Members of the European Parliament, that have supported and continue to support the solution of the Lindane Legacy.

#### **ACKNOWLEDGEMENT IHPA BOARD**

The actual Board members:

Bram de Borst (Chair)

André Schroer (Board member and Financial Officer / Treasurer)

John Vijgen (Director and Board member)

would like to express their great thanks and gratitude for the great efforts of those who gave support to IHPA as Board member over a shorter or longer period in the last 32 years.

Members (alphabetical order):

Gulchohra (Giulia) Aliyeva)

Ion Barbarasa

Bram de Borst

Branko Druzina

Ivan Holoubek

Wieslaw Kuc

Valentin Plesca

André Schroer

Stanislaw Stobiecki

Tomasz Stobiecki

Konstantin Tervtze

John Vijgen – Director

Apart from their position in the Board they have been active in enabling the 14 IHPA Forums by convincing governments to host the IHPA Forums, by leading the build of local capacities for the Forum organization, by promoting participation of governmental representatives, scientists, NGO's and those who suffer the effects of obsolete pesticides.

Finally, we like to thank the **Newsletter editors**: Editor: B. Sugavanam, Co-editors: Ivan Holoubek, Sushil Khetan, Otar Kiria, and Editor Mahbubar Rahman (<a href="http://www.ihpa.info/resources/newsletter/">http://www.ihpa.info/about/ambassadors/</a>).

# **TABLE OF CONTENTS**

Introduction	13
OPENING OF THE FORUM	16
Feature article. HCH AND OBSOLETE PESTICIDES CASE EVALUATION. LONG TERM PERSPECTIVE	28
Vijgen, J., Eufemi, M., Natali, P.G., Toichuev, R., Toichueva, A., Zhilova, L., Paizyldaev, T., Forter, M.  DEVELOPMENT OF APPROACHES TO REMOVE TOXIC SUBSTANCES FROM THE ENVIRONMENT AND NEW  POTENTIAL ALTERNATIVES (POSSIBLE ROADS) TO TREAT CONTAMINATED INHABITANTS (BASED ON 4 CASE  STUDIES) - in progress	
Block 1 LIFE SURFING	29
Net, J., Cano, E., Fernández, J., Velilla, S.M. LIFE SURFING: SURFactant enhanced chemical oxidation for remediatING DNAPL	30
Sánchez-Valverde, A., Romero, P., Peiro, A., Arjol, M.A., Herranz, C., Cano, E., Fernández, J. LIFE SURFING: FACILITIES, EQUIPMENT, CONSUMABLES, AND RESOURCES IN THE TEST EXECUTION	34
Fernández, J. Santos, A., Herranz, C., Cano, E., Lorenzo, D., Arjol, M.A. LIFE SURFING PROJECT, PREPARATORY WORKS FOR THE INJECTION OF SURFACTANTS AND OXIDANTS	40
Fernández, J. Santos, A., Herranz, C., Net, J., Lorenzo, D., Arjol, M.A. LIFE SURFING PROJECT, ENHANCED SURFACTANTS EXTRACTION (SEAR) IN A FRACTURED AQUIFER.	45
Fernández, J., Santos, A., Herranz, C., Net, J., Saez P., Arjol, M.A., Lorenzo, D. LIFE SURFING PROJECT, IN SITU CHEMICAL OXIDATION ENHANCED WITH SURFACTANTS (SISCO) IN A FRACTURED AQUIFER	50
Sanchez-Yepes, A., Santos, A., Fernández, J., Herranz, C., Cano, E., Lorenzo, D. LIFE SURFING PROJECT: CONTAMINATED EMULSION TREATMENT by ADSORPTION in GAC and ADSORBENT REGENERATION.	55
Herranz, C., Fernández, J., Santos, A., Salvatierra, A., Cano, E. Lorenzo, D., Arjol, M.A. ON SITE REMEDIATION OF FLUIDS EXTRACTED IN SEAR TREATMENT IN THE LIFE SURFING PROJECT AT BAIIÍN — SABIÑÁNIGO (HUESCA): SELECTIVE POLLUTANTS OXIDATION AND ADSORPTION.	59
Herranz, C., Arjol, M. A., Fernández, J., Santos, A. ON SITE ALKALINE HYDROLISIS OF FLUIDS EXTRACTED IN SEAR TREATMENT IN THE LIFE SURFING PROJECT AT BAILIN – SABIÑÁNIGO (HUESCA)	63
Block 2. STRATEGY-INFRASTRUCTURE-MONITORING SABINANIGO MEGA-SITE SESSION	68
Cano, E., Fernández, J., Net, J., Velilla, S.M., Monge, L., Arjol, M.A. CASE STUDY OF THE INFLUENCE OF GEOLOGY AND THE PRESENCE OF DIFFERENT MATRICES ON THE APPLICABILITY OF HCH REMEDIATION TECHNOLOGIES.	70
Velilla, S.M., Cano, E., Monge, L., Visanzay, A. UNIQUE STRATEGIC PROJECTS IN THE SITES AFFECTED BY HCH IN ARAGON.	74
Guadaño, J., Gómez, J., Granados, E., Fernández, J. MULTIDISCIPLINARY PERSPECTIVE OF THE ENVIRONMENTAL MANAGEMENT OF THE SARDAS SITE.	78
Monge, L., Velilla, S.M., Cano, E., Fernández, J., Net, J. PURIFICATION, ANALYSIS AND LABORATORY MANAGEMENT SERVICE, TECHNICAL ASSISTANCE TO THE FACULTY MANAGEMENT AND MONITORING FOR SPACES AFFECTED BY HCH CONTAMINATION.	83
Ruiz, A., Arjol, M.A., Monge, L., Gonzalvo, P., Velilla, S.M., Cano, E., Fernández, J., Net, J. ENVIRONMENTAL MONITORING IN THE SURROUNDINGS OF THE SPACES AFFECTED BY THE RESIDUE FROM THE MANUFACTURE OF THE HEXACHLOROCYCLOHEXANE PESTICIDE IN THE TOWN OF SABIÑANIGO.	86
Arjol, M.A., Monge, L., Cano, E., Velilla, S.M., Fernández, J., Net, J. AIR QUALITY MEASUREMENT TASKS IN RELATION TO THE DECONTAMINATION WORKS OF MANUFACTURING WASTE OF THE HEXACHLOROCYCLOHEXANE PESTICIDE IN THE TOWN OF SABIÑÁNIGO.	90

Gonzalvo, P., Ruiz, A., Monge, L., Velilla, S.M., Cano, E., Fernández, J., Net, J. LABORATORY HCH SABIÑÁNIGO-REFERENCE CENTER IN RESEARCH ON PERSISTENT ORGANIC COMPOUNDS.	98
Ayala, C., Monge. L., Cano, E., Velilla, S.M., Fernández, J., Net, J. INTEGRAL MANAGEMENT OF THE PREVENTION OCCUPATIONAL RISKS IN THE EXPLOITATION, EXECUTION OF WORKS AND SPECIAL ACTIONS, INVESTIGATION, AND REMEDIATION OF SOILS AND/OR SITES CONTAMINATED BY HCH.	102
Navarro, I., de la Torre, A., Arjol, M. A., Fernández, J., Martínez, M. A. PERSISTENT PESTICIDES IN AIR FROM A FORMER HCH PRODUCTION SITE IN SPAIN.	108
Muñoz-Arnanz, J., Colomer-Vidal, P., Ros, M., Vicente, A., Salcedo, C., Bartalini, A., Jiménez, B. ATMOSPHERIC HCH CONCENTRATIONS (2008-2019) FROM THE SPANISH MONITORING PROGAM ON POPs.	112
Samper, J., Sobral, B., Montenegro, L., Guadaño, J., Gómez, J., Delgado, F., San Román, J., Fernández, J.  2D MODEL OF GROUNDWATER FLOW AND DISSOLVED HCH TRANSPORT THROUGH THE GÁLLEGO RIVER ALLUVIAL AQUIFER DOWNSTREAM THE SARDAS HCH LANDFILL (HUESCA, SPAIN).	115
Gómez, J., Guadaño, J., Samper, J., Sobral, B., Suso, J., Fernández, J. TRACER TESTS IN THE HCH-AFFECTED ALLUVIAL AQUIFER DOWNSTREAM THE SARDAS LANDFILL (HUESCA, SPAIN).	121
Samper J., Sobral B., Pisani B., Montenegro, L., Guadaño, J., Gómez, J., Fernández, J. 3D GROUNDWATER FLOW AND CONTAMINANT TRANSPORT MODEL OF THE SARDAS LANDFILL (HUESCA, SPAIN).	126
Rodríguez-Arévalo, J., Castaño, S., Martín-Ruiz, M., Rodríguez-Abad, R., Asanza, E., Delgado, F., San Román, J. DIAGNOSIS OF LINDANE CONTAMINATION OF THE SARDAS LANDFILL (SABIÑÁNIGO) IN THE GÁLLEGO RIVER AND PROPOSAL FOR ACTION	131
Alonso, T., Alcalde, D., Escobar-Arnanz, J., Encinas, R., Fernández, J. MASS DISCHARGE TEMPORAL EVALUATION IN A TRANSECT LOCATED IN THE DISCHARGE ZONE TO THE GALLEGO RIVER IN BAILIN LANDFILL, SABIÑANIGO (HUESCA).	135
Block 3: WASTE AND SOIL TECHNOLOGIES. Waste Management experiences, Destruction technologies	140
Hamon, G., Cunin, A. TREATMENT AND RECOVERY OF HAZARDOUS WASTE MANAGEMENT	142
Hamon, G., Cunin, A. TREATMENT AND RECOVERY OF HAZARDOUS WASTE MANAGEMENT  Follin, J. (ONLINE) COMMERCIAL ORGANIC CHEMICAL WASTE DESTRUCTION USING SUPERCRITICAL WATER OXIDATION.	142 145
Follin, J. (ONLINE) COMMERCIAL ORGANIC CHEMICAL WASTE DESTRUCTION USING SUPERCRITICAL WATER	
Follin, J. (ONLINE) COMMERCIAL ORGANIC CHEMICAL WASTE DESTRUCTION USING SUPERCRITICAL WATER OXIDATION.  Eriksen, S., Ploug, N., Nielsen, S.G. CAN LOW TEMPERATURE THERMAL DESORPTION BE CONVERTED TO	145
Follin, J. (ONLINE) COMMERCIAL ORGANIC CHEMICAL WASTE DESTRUCTION USING SUPERCRITICAL WATER OXIDATION.  Eriksen, S., Ploug, N., Nielsen, S.G. CAN LOW TEMPERATURE THERMAL DESORPTION BE CONVERTED TO DESTRUCTION AND BE MORE SUSTAINABLE THAN TRADITIONAL INCINERATION"	145 148
Follin, J. (ONLINE) COMMERCIAL ORGANIC CHEMICAL WASTE DESTRUCTION USING SUPERCRITICAL WATER OXIDATION.  Eriksen, S., Ploug, N., Nielsen, S.G. CAN LOW TEMPERATURE THERMAL DESORPTION BE CONVERTED TO DESTRUCTION AND BE MORE SUSTAINABLE THAN TRADITIONAL INCINERATION.  Hallett, D. (ONLINE). HYDROGEN REDUCTION OF HCH, PCBS, AND PLASTIC.  Zheng Peng (VIDEO). PROGRESS IN ENVIRONMENTALLY SOUND MANAGEMENT AND DISPOSAL OF PESTICIDE	145 148 151
Follin, J. (ONLINE) COMMERCIAL ORGANIC CHEMICAL WASTE DESTRUCTION USING SUPERCRITICAL WATER OXIDATION.  Eriksen, S., Ploug, N., Nielsen, S.G. CAN LOW TEMPERATURE THERMAL DESORPTION BE CONVERTED TO DESTRUCTION AND BE MORE SUSTAINABLE THAN TRADITIONAL INCINERATION.  Hallett, D. (ONLINE). HYDROGEN REDUCTION OF HCH, PCBS, AND PLASTIC.  Zheng Peng (VIDEO). PROGRESS IN ENVIRONMENTALLY SOUND MANAGEMENT AND DISPOSAL OF PESTICIDE POPS WASTES IN CHINA.  Papiol, M. HIGH TEMPERATURE INCINERATION OF POPS AND HAZARDOUS WASTE IS THE PROPER	145 148 151 153
Follin, J. (ONLINE) COMMERCIAL ORGANIC CHEMICAL WASTE DESTRUCTION USING SUPERCRITICAL WATER OXIDATION.  Eriksen, S., Ploug, N., Nielsen, S.G. CAN LOW TEMPERATURE THERMAL DESORPTION BE CONVERTED TO DESTRUCTION AND BE MORE SUSTAINABLE THAN TRADITIONAL INCINERATION.  Hallett, D. (ONLINE). HYDROGEN REDUCTION OF HCH, PCBS, AND PLASTIC.  Zheng Peng (VIDEO). PROGRESS IN ENVIRONMENTALLY SOUND MANAGEMENT AND DISPOSAL OF PESTICIDE POPS WASTES IN CHINA.  Papiol, M. HIGH TEMPERATURE INCINERATION OF POPS AND HAZARDOUS WASTE IS THE PROPER TREATMENT TO DESTROY THEM.	<ul><li>145</li><li>148</li><li>151</li><li>153</li><li>157</li></ul>
Follin, J. (ONLINE) COMMERCIAL ORGANIC CHEMICAL WASTE DESTRUCTION USING SUPERCRITICAL WATER OXIDATION.  Eriksen, S., Ploug, N., Nielsen, S.G. CAN LOW TEMPERATURE THERMAL DESORPTION BE CONVERTED TO DESTRUCTION AND BE MORE SUSTAINABLE THAN TRADITIONAL INCINERATION.  Hallett, D. (ONLINE). HYDROGEN REDUCTION OF HCH, PCBS, AND PLASTIC.  Zheng Peng (VIDEO). PROGRESS IN ENVIRONMENTALLY SOUND MANAGEMENT AND DISPOSAL OF PESTICIDE POPS WASTES IN CHINA.  Papiol, M. HIGH TEMPERATURE INCINERATION OF POPS AND HAZARDOUS WASTE IS THE PROPER TREATMENT TO DESTROY THEM.  Martinov, S. DDT DISPOSAL IN BANGLADESH.	145 148 151 153 157 159
Follin, J. (ONLINE) COMMERCIAL ORGANIC CHEMICAL WASTE DESTRUCTION USING SUPERCRITICAL WATER OXIDATION.  Eriksen, S., Ploug, N., Nielsen, S.G. CAN LOW TEMPERATURE THERMAL DESORPTION BE CONVERTED TO DESTRUCTION AND BE MORE SUSTAINABLE THAN TRADITIONAL INCINERATION."  Hallett, D. (ONLINE). HYDROGEN REDUCTION OF HCH, PCBS, AND PLASTIC.  Zheng Peng (VIDEO). PROGRESS IN ENVIRONMENTALLY SOUND MANAGEMENT AND DISPOSAL OF PESTICIDE POPS WASTES IN CHINA.  Papiol, M. HIGH TEMPERATURE INCINERATION OF POPS AND HAZARDOUS WASTE IS THE PROPER TREATMENT TO DESTROY THEM.  Martinov, S. DDT DISPOSAL IN BANGLADESH.  Plesca, V., Cupcea, L., Barbarasa., I. OBSOLETE PESTICIDES MANAGEMENT AND DESTRUCTION IN MOLDOVA.  Plesca, V., Barbarasa, I., Cupcea, L., Kubricht, J., Polak, M. MANAGEMENT OF POPS CONTAMINATED SITES IN	<ul><li>145</li><li>148</li><li>151</li><li>153</li><li>157</li><li>159</li><li>162</li></ul>
Follin, J. (ONLINE) COMMERCIAL ORGANIC CHEMICAL WASTE DESTRUCTION USING SUPERCRITICAL WATER OXIDATION.  Eriksen, S., Ploug, N., Nielsen, S.G. CAN LOW TEMPERATURE THERMAL DESORPTION BE CONVERTED TO DESTRUCTION AND BE MORE SUSTAINABLE THAN TRADITIONAL INCINERATION."  Hallett, D. (ONLINE). HYDROGEN REDUCTION OF HCH, PCBS, AND PLASTIC.  Zheng Peng (VIDEO). PROGRESS IN ENVIRONMENTALLY SOUND MANAGEMENT AND DISPOSAL OF PESTICIDE POPS WASTES IN CHINA.  Papiol, M. HIGH TEMPERATURE INCINERATION OF POPS AND HAZARDOUS WASTE IS THE PROPER TREATMENT TO DESTROY THEM.  Martinov, S. DDT DISPOSAL IN BANGLADESH.  Plesca, V., Cupcea, L., Barbarasa., I. OBSOLETE PESTICIDES MANAGEMENT AND DESTRUCTION IN MOLDOVA.  Plesca, V., Barbarasa, I., Cupcea, L., Kubricht, J., Polak, M. MANAGEMENT OF POPS CONTAMINATED SITES IN MOLDOVA: CISMICHIOI LANDFILL.  Lud, D., Schwemm, D., Babaev, E., Kalandadze, B., Simon, M.P., Weller, P., Düring, R-A. PESTICIDE INFORMATION SOURCES AND WASTE MANAGEMENT – SURVEY RESULTS FROM AZERBAIJAN COMPARED TO	145 148 151 153 157 159 162 167

MERCURY.

IMPLEMENTATION SYNERGY OF THE MINAMATA & STOCKHOLM CONVENTION.	178
Jelinek, N. MERCURY CONTAMINATION AS A LEGACY OF CHEMICAL PRODUCTION IN THE CEE REGION.	179
Van de Coterlet, G. WHERE STOCKHOLM MEETS MINAMATA – MERCURY AND HCH ISSUES AS CHLOR-ALKALI FACILITIES.	185
$\textbf{Ibarz, X.} \   \textbf{ECON INDUSTRIES: VACUDRY}  \textbf{TECHNOLOGY, CASE STUDY: MERCURY AND HCH WASTE TREATMENT FROM CHLOR-ALKALI PLANTS.}$	189
Castellnou, A. BATREC: TREATMENT OF MERCURY AND MERCURY WASTES: MERCURY STABILIZATION AND SAFE DISPOSAL.	194
Castellnou, A. BATREC: HG DECONTAMINATION: CASE STUDIES IN SPAIN AND ABROAD, INCLUDING MERCURY BASED CHLOR-ALKALI PLANT DECOMMISSIONING.	197
Fokke, B. ASGM (ARTISANAL AND SMALL-SCALE GOLD MINING) PROJECT INDONESIA	201
Conde Carrasco, A., Javier, F. REMEDIATION OF MERCURY CONTAMINATED SITE. THE CASE OF ALMADEN DUMP AND THE ANTIQUE MERCURY METALLURGY FACILITIES OF ALMADENEJOS CERCO.	206
Block 5: BIOREMEDIATION	208
De Graaff, D., Praamstra, T., Masini, C. MICROBIOME BASED REMEDIATION AND OTHER NATURE BASED TECHNIQUES	210
Masini, C., Brogioli, F. INTEGRATED SUSTAINABLE APPROACH TO LINDANE.	214
Aguilar Bel, D., García Valero, A. BIODEGRADATION OF LINDANE THROUGH THE USE OF THE DAB TECHNOLOGY.	217
Soder-Walz, J. M., Fernández-Verdejo, D., Salom, D., Marco-Urrea, E., Vicent, T., Blánquez, P. LAB STUDIES LEADING TO DECISION-MAKING FOR IN SITU BIOREMEDIATION OF ORGANOHALIDES.	222
Kuntze, K., Richnow, H., Fischer, A. SOURCE ALLOCATION AND DEGRADATION EVALUATION OF HCHs WITHIN A CONTAMINATED AQUIFER USING COMPOUND-SPECIFIC STABLE CARBON ISOTOPE ANALYSIS (CSIA).	225
Escobar-Arnanz, J., Berganza, J., Brettes, P., Encinas, R., Alonso, T., Alcalde, D., Fernández, J. ANALYSIS OF MICROBIAL COMMUNITIES FOR THE IDENTIFICATION OF INOCULANTS FOR AN IN-SITU BIOREACTOR FOR TREATING HCH CONTAMINATION IN GROUNDWATER.	229
Granados, E., Herranz, C., Salvatierra, A., Guadaño, J., Fernández, J. CHARACTERIZATION OF NATURALLY PRESENT MICROBIAL POPULATION AT SARDAS' LANDFILL AND INQUINOSA FACTORY IN SABIÑANIGO, HUESCA.	234
Escobar-Arnanz, J., Encinas, R., Alonso, T., Alcalde, D., Fernández, J. APPLICATION OF MOLECULAR BIOLOGICAL TOOLS AND ISOTOPIC ANALYSIS FOR BIOGEOCHEMICAL CHARACTERIZATION OF FRACTURED BEDROCK AQUIFER IMPACTED BY DNAPL.	240
Beltrán-Flores, E., Pla-Ferriol, M., Martínez-Alonso, M., Gaju, N., Sarrà M., Blánquez, P. PRELIMINARY STUDIES TO IMPLEMENT A PILOT REACTOR FOR THE BIOLOGICAL REMOVAL OF PESTICIDES FROM AGRICULTURAL WASHING WASTEWATER.	245
Escobar-Arnanz, J., Berganza, J., Brettes, P., Encinas, R., Alonso, T., Alcalde, D., Fernández, J. DESIGN, DEVELOPMENT AND SCALE-UP OF AN AEROBIC IN-SITU BIOREACTOR FOR REMOVAL OF HCH IN GROUNDWATER.	248
Doolotkeldieva, T. D., Konurbaeva, M. U. APPLICATION OF THE METHOD OF PHYTOREMEDIATION OF PESTICIDE CONTAMINATED SOILS IN A FIELD EXPERIMENTAL PLOT IN CHIM-KORGON VILLAGE	252
González, J., Mancho, C., Gil-Díaz, M., García-Gonzalo, P., Lobo, M.C. ASSISTED-BIOREMEDIATION FOR THE DEGRADATION OF ORGANOCHLORINE COMPOUNDS.	255
Seech, A., Mueller, M. ENHANCED BIOREMEDIATION OF SOIL CONTAMINATED WITH LINDANE AND OTHER	258

CHLORINATED PESTICIDES USING ZVI/ORGANIC CARBON REAGENTS.

Santos, A., Checa-Fernández, A., Domínguez, C.M., Martín-Sanz, J.P., Valverde-Asenjo, I., Quintana-Nieto, J.R., Fernández-Sanjulián, J., Chicaiza-Guerra, K.Y. PRELIMINARY STUDY OF THE BIOREMEDIATION CAPACITY OF HORSE AMENDMENT IN SOILS CONTAMINATED WITH HCHS.	262
Block 6: WASTE AND SOIL TECHNOLOGIES. In-Situ remediation technologies	267
Vandenbruwane, J., Counet, L. SPIN® INJECTION TECHNOLOGY OR HOW TO PERFORM QUALITY INJECTIONS FOR AN OPTIMAL RESULT, EVEN IN LOW PERMEABILITY OR HETEROGENEOUS SOILS. EXPLANATIONS THROUGH THE CASE OF LINDANE.	269
Maire, J., Joubert, A., Bouzid, I., Fatin-Rouge, N., Laurent, F., Broquaire, M. INNOVATIVE HCH IN-SITU REMEDIATION USING POLYMER GEL AS A REAGENT CARRIER – RESULTS AT FIELD SCALE.	272
Carboni, M., Shore, J. INSTALLATION, COMMISSIONING AND OPERATION OF AN INJECTABLE IN SITU PERMEABLE REACTIVE BARRIER TO PREVENT THE ADVECTION OF PER-AND POLYFLUOROALKYL SUBSTANCES AT A EUROPEAN AIRPORT.	273
Escobar-Arnanz, J., Encinas, R., Alonso, T., Alcalde, D., Fernández, J. DESIGN, OPERATIONAL AND PROCEDURES FOR THE APPLICATION OF IN SITU CHEMICAL OXIDATION TREATMENTS IN FRACTURED BEDROCK AQUIFER IMPACTED BY AN OLD DNAPL.	275
Checa-Fernández, A., Santos, A., Romero, A., Domínguez, C.M. REMEDIATION OF HCHs-POLLUTED SOILS BY SURFACTANT-ENHANCED WASHING AND ACTIVATED PERSULFATE OXIDATION.	279
Alonso, T., Alcalde, D., Escobar-Arnanz, J., Encinas, R., Fernández, J. AIR SPARGING AND SOIL-VAPOR EXTRACTION PILOT TESTS IN BAILIN LANDFILL, SABIÑANIGO (HUESCA).	284
Santos, A., Lorenzo, D., Domínguez, C.M., Cotillas, S., García Cervilla, R., Fernández, J., Guadaño, J., Gómez, J. PILOT TEST SEAR APPLICATION IN SARDAS LANDFILL REMEDIATION.	289
Lorenzo, D., Domínguez, C.M., García Cervilla, R., Santos, A., Checa-Fernández, A., Fernández, J., Guadaño, J., Gómez, J. ISCO AND S-ISCO EVALUATION IN THE REMEDIATION OF SARDAS ALLUVIUM.	293
Isidro, J., Fernández-Cascán, J., Guadaño, J., Sáez, C., Rodrigo, M.A. DESIGN AND VALIDATION OF ELECTROKINETIC TECHNIQUES FOR THE REMEDIATION OF THE ALLUVIAL SILT OF THE SARDAS LANDFILL (SABIÑANIGO) CONTAMINATED WITH HCHs.	297
Isidro, J., Fernández-Cascán, J., Guadaño, J., Sáez, C., Rodrigo, M.A. DISMANTLING STRATEGIES FOR HIGHLY HCH-POLLUTED LANDFILL LEACHATE DUMP USING ELECTROCHEMICALLY ASSISTED TECHNOLOGY.	300
Block 7: LIFEPOPWAT SESSION	303
Černík, M., Hrabák, P., Brůček, P. WETLAND+® TECHNOLOGY: TREATMENT OF HCH CONTAMINATED WATER BY A PASSIVE BIOLOGICALLY BASED REMEDIATION SYSTEM.	304
Kończak, B., Gzyl, G., Moycho-Jędros, J., Kvapil, P., Ptackova, H., Wasiński, P., Łabaj, P., Antos, V. Cernik, M. Adamczyk, M., Skalny, A., Wiesner-Sękala, M., Ratajski, P. ADAPTATION OF METHODOLOGICAL ASSUMPTIONS FOR DESIGN OF PILOT SCALE WETLAND+ INSTALLATION FOR WATER TREATMENT FROM HCH TAKING INTO ACCOUNT PRACTICAL LESSONS FROM DIFFICULT FIELD CONSTRUCTION PROCESS IN JAWORZNO, POLAND (LIFEPOPWAT PROJECT).	307
Němeček, J., Brůček, P., Hrabák, P., Černík, M. EXPERIENCE FROM OPERATION AND TUNNING OF WETLAND+®. TECHNOLOGY FOR TREATMENT OF HCH-CONTAMINATED WATER.	313
Štrojsová, M., Balej, T. Hrabák, P., Černík, M. BENTHIC DIATOMS AS INDICATOR OF ENVIRONMENTAL IMPACT OF WETLAND+® TECHNOLOGY FOR TREATMENT OF HCH-CONTAMINATED WATER.	316
Arias, C.A. BENEFITS OF THE PRESENCE OF PLANTS IN WETLAND+ SYSTEM TREATING HCH POLLUTED SITES.	321
Vrchovecká, S., Sázavská, T., Lísková, K., Hrabák, P. GROUNDWATER HCH INDICATION VIA PHYTOSCREENING OF TREES.	323

Svermova, P., Buresova, J., Bardos, P., and Černík, M. SURVEY ON SOCIO-ECONOMIC IMPACT FOR 328

WETLAND+®.

Joubert, A., Kvapii, P. PROTOCOLS OFFER TO THE CLIENTS FOR WETLAND+* REPLICATION.	333
Block 8. HCH IN EU SESSION	334
Vijgen, J., Fokke, B., Van de Coterlet, G., Amstaetter, K., Sancho, J., Bensaïah, C., Weber, R. EUROPEAN COOPERATION TO TACKLE THE LEGACIES OF HEXACHLOROCYCLOHEXANE (HCH) AND LINDANE	335
Fokke, B. INTRODUCTION HCH IN EU PROJECT	343
Amstaetter, K. INVENTORY RESULTS FOR GERMANY	343
Van de Cotelet, G. THE GEOGRAPHIC INFORMATION MODEL.	343
Sancho, J. ROAD MAP TO SUSTAINABLY MANAGE HCH CONTAMINATED SITES.	344
Fokke, B. GUIDELINES SC POP CONTAMINATED SITE MANAGEMENT.	344
Vijgen, J. EU WIDE STRATEGY TO MANAGE HCH CONTAMINATED SITES.	345
Block 9: HCH CASES - LINDANE NETWORK AND OTHERS	346
Cano, E., Sánchez, A., Camiño, J.M., Hanzal, Z., Trump, M., Gzyl, G., Neri, B. LINDANET: EUROPEAN NETWORK OF LINDANE WASTE AFFECTED REGIONS WORKING TOGETHER TOWARDS A GREENER ENVIRONMENT.	348
Torres, J., De Souza, Y., Vijgen, J. HCH IN BRAZIL-SOCIALIZING CHEMICAL RISKS AND OTHERS.	352
Chaos, Z., Celeiro, M., García-Jares, C., Monterroso, C. SPATIAL DISTRIBUTION OF HEXACHLOROCYCLOHEXANE ISOMERS IN OAK LEAVES AND TOPSOIL FROM O PORRIÑO (NW SPAIN).	355
Revuelto Palau, D., Fernández Cascán, J., Corujo Cristobal, J.M., Sainz Gutiérrez, R. CHARACTERIZATION AND MANAGEMENT OF LINDANE-CONTAINING WASTE AT AN ABANDONED LINDANE PRODUCTION FACILITY IN HUESCA PROVINCE (SPAIN). A SITE-SPECIFIC PROTOCOL DESIGN FOR WASTE CONDITIONING AND HANDLING FOR EX SITU FINAL TREATMENT.	358
Forter, M. (ONLINE). THE EXAMPLE OF UGINE-KUHLMANN HUNIGUE/FRANCE: THE REMEDIATION OF NOVARTIS AND THE QUESTION: DOES THE FRENCH INVENTORY FULLY COVERS THE LINDANE WASTE OF THIS LINDANE FACTORY?	361
PLCH, J. (ONLINE) POLLUTION BY PESTICIDES, LINDANE AND SIMILAR SUBSTANCES IN SLOVAKIA.	365
Mickovski A., Andonova, S. REMOVAL OF TECHNICAL AND ECONOMIC BARRIERS TO INITIATING THE CLEAN-UP ACTIVITIES FOR ALPHA-HCH, BETA-HCH AND LINDANE CONTAMINATED SITES AT OHIS.	371
Avramikos, I., Tsaimos, G., Prekas, K. REMOVAL OF TECHNICAL AND ECONOMIC BARRIERS TO INITIATING THE CLEAN-UP ACTIVITIES FOR ALPHA-HCH, BETA-HCH AND LINDANE CONTAMINATED SITES AT OHIS.	376
Block 10: LIFECYCLE MANAGEMENT OF PESTICIDES AND DISPOSAL IN CENTRAL ASIA COUNTRIES AND TÜRKIYE SESSION	379
Davis, M. ARE PESTICIDES OBSOLETE?	380
<b>Swain, E.</b> INTRODUCING A DONOR PERSPECTIVE ON POPS MANAGEMENT WORK IN THE CENTRAL ASIA REGION.	380
Robinson, S. INVENTORIES AND ASSESSMENT OF REGIONAL DISPOSAL OPTIONS.	381
<b>Doolotkeldieva, T.</b> IN SITU IMPLEMENTATION OF TRIALS ON MICROBIOLOGICAL REMEDIATION OF POPS CONTAMINATED SOILS IN KYRGYZSTAN (SUBM).	381
<b>Nurzhanova, A.</b> PHYTOREMEDIATION OF POPS-CONTAMINATED SOILS: SOLUTIONS AND DEVELOPMENT PROSPECTS IN KAZAKHSTAN.	384
Ulughov, U. AWARENESS RAISING WORK IN MINI-LANDFILL AREAS IN TAJIKISTAN + PLANNING OF REMEDIATION OF VILLAGE #1 MINI-LANDFILL.	385

Efimkin, A. EMPTY PESTICIDES CONTAINER MANAGEMENT.	385
Loayza, A. HIGHLY HAZARDOUS PESTICIDES ASSESSMENT.	385
Robinson, S. SUGGEST INITIATIVE ON RESOLVING POPS LEGACY IN CENTRAL ASIA.	386
Toichuev R., Paizildaev T., Zhilova L, Toichueva A. THE PROBLEMS OF PESTICIDES IN SOUTHERN KYRGYZSTAN AND ASSESSMENT OF THE POSSIBILITIES OF USING VEGETABLES FOR SOIL REMEDIATION.	386
Block 11: TOXICOLOGY: NEW APPROACHES TO TESTING OF CHEMICALS BASED ON OMICS AND EPIDEMIOLOGY: EXAMPLE DEVELOPMENTAL NEUROTOXICITY	393
Part I: Exposure of wildlife and humans to chemicals	394
Vijgen, J. DEVELOPMENT OF APPROACHES TO REMOVE TOXIC SUBSTANCES FROM THE ENVIRONMENT.	394
Cardoso, P. GLOBAL EFFECTS OF POLLUTANTS AND OTHER RISK FACTORS ON INVERTEBRATE FAUNA.	394
Yago de Souza Guida, Joao PM Torres, Rodrigo Ornellas Meire. BRAZILIAN PEOPLE STILL UNDER INCREASED RISK OF CANCER DEVELOPMENT DUE TO HEXACHLOROCYCLOHEXANE INHALATION EXPOSURE.	395
Part II: New approaches to testing of chemicals based on OMICs and epidemiology: Example developmental neurotoxicity	396
Rüegg, J. CONCEPT: EPIDEMIOLOGY- AND OMICS-BASED DEVELOPMENT OF AN IN VITRO TEST BATTERY FOR DEVELOPMENTAL NEUROTOXICITY.	396
Bornehag, C. EPIDEMIOLOGY IN CHILDREN AS A BASIS FOR TEST DEVELOPMENT.	396
Lichtensteiger, W. USE OF COMPARATIVE TRANSCRIPTOMICS FOR TEST DEVELOPMENT.	397
Rüegg, J. CONTRIBUTION OF EPIGENETICS TO TEST DEVELOPMENT.	397
Leonards, P. ROLE OF METABOLOMICS IN TEST DEVELOPMENT AND CONCLUSIONS.	398
Block 12: EMERGING POLLUTANTS. PFAS SESSION	399
<b>Horel, S.</b> PFAS CONTAMINATION AND PRESUMPTIVE CONTAMINATED SITES IN EUROPE – WHAT NEED TO BE KNOWN BY THE PUBLIC AND GOVERNMENTS.	400
Weber, R. PFAS CONTAMINATED SITES – A PERSONAL JOURNEY AND SOE; LESSONS LEARNED.	407
Frauenstein, J. PFAS IN SOIL AND GROUNDWATER – PROGRESS AND COMPREHENSIVE CHALLENGES IN GERMANY.	408
Lange, F. T. INVESTIGATIVE SOIL AND WATER ANALYSIS AT AN OUTSTANDING LARGE-SCALE CONTAMINATED SITE: HOW NOVEL APPROACHES CAN HELP TO SOLVE THE PFAS PUZZLE.	409
Schroeters, G. THE BELGIUM 3M CASE FROM A HEALTH PERSPECTIVE.	410
Ceenaeme, J. PFAS POLICY FOR SOIL AND GROUNDWATER IN FLANDERS (BELGIUM).	411
Trier, X. THE CRITICAL ROLE OF CHEMICAL REFERENCE STANDARDS IN THE RISK GOVERNANCE OF CHEMICALS	412
Müller-Grabherr, D. FOREVER CHEMICALS" VS. "ONE HEALTH" – PFAS, A CALL TO RETHINK HOW WE MANAGE CONTAMINATED LAND!	413
Ustinov, S. PER-AND POLY-FLUORALKYL SUBSTANCES (PFAS) AND THE GLOBAL DIMENSION OF SOIL POLLUTION	414
Block 13: PCB MANAGEMENT	415
SUMMARY OF THE SESSION PCB MANAGEMENT	417
Hoogendoorn, D.J. PCB PROJECTS IN EMERGING ECONOMIES: NEED FOR LOCAL TREATMENT, STOCKHOLM CONVENTION DEADLINE 2028, TRANSPORT AND EXPORT OBSTACLES.	419

Barbarasa, I., Plesca, V., Cupcea, L., Marduhaeva, L. PCB MANAGEMENT AND ELIMINATION IN MOLDOVA	421
Gil-Díaz, M., Pérez, R. A., Alonso, J., Miguel, E., Diez-Pascual, S., Lobo, M.C. NANOREMEDIATION OF A SOIL POLLUTED WITH PCBS AND CR.	426
Weber, R. MONITORING DIOXINS AND PCBS IN EGGS AS SENSITIVE INDICATORS FOR ENVIRONMENTAL POLLUTION AND GLOBAL CONTAMINATED SITES AND RECOMMENDATIONS FOR REDUCING AND CONTROLLING RELEASES AND EXPOSURE.	431
Bilger, E. SODIUM TECHNOLOGY – THE CHOICE FOR TREATMEN T OF PCB AND POP'S.	441
Wauters, F. PCB DECONTAMINATION: AUTOCLAVE TECHNOLOGY. CASE STUDY: TREATMENT OF PCB CONTAMINATED TRANSFORMERS.	442
<b>Ottermann, E.W.</b> THE SUB-SAHARAN CEMENT INDUSTRY POTENTIAL FOR THE DESTRUCTION OF POP'S, PCB AND OTHER HAZARDOUS CHEMICALS.	443
Verhamme, E. CO-PROCESSING PCB & OTHER POP'S IN CEMENT KILNS A LOCAL SOLUTION.	444
Aleksandryan, A., Khachatryan, A. INVESTIGATION FOR DIOXINS / FURANS AND DIOXIN-LIKE POLYCHLORINATED BIPHENYLS IN ARMENIA.	445
Block 14: TOXICOLOGY: CHEMICAL EXPOSURE OF WILDLIFE AND HUMANS	447
Morcelle, S., Tirado, L. PESTICIDES AND WILDLIFE FRIENDLY FARMING	448
Iannetta, A., Perugini, M., Amorena, M., Gentile, W., Angelozzi G., Della Salda, L., Massimini, M. TOXICOLOGICAL EVALUATIONS OF GLYPHOSATE IN ZEBRAFISH EARLY-LIFE STAGES	451
Mahdavi, A., Vijgen, J. HIGHLY HAZARDOUS PESTICIDES (HHP) IN EU COMPARED TO DEVELOPING COUNTRIES, CASE STUDY: HHP HISTORY AND USE IN IRAN.	454
Minacori, M., Natali, P. G., Paglia, G., Fiorini, S., Altieri, F., Eufemi, M. TOMATO AND OLIVE MICRONUTRIENTS AS "HUMAN BODY REMEDIATION" IN PEOPLE LIVING IN CONTAMINATED AREAS: FOCUS ON B-HEXACHLOROCYCLOHEXANE.	470
Toichuev, R., Toichueva, A., Zhilova, L., Paizyldaev, T. (Online in English in Kyrgyzstan). THE USE OF THERAPEUTIC AGENTS DERIVED FROM THE PLANTS AND FRUITS GROWING IN KYRGYZSTAN FOR THE ELIMINATION OF ORGANOCHLORINE PESTICIDES FROM GASTROINTESTINAL TRACT OF NURSING WOMEN.	475
Paizildaev, T., Zhilova, L., Toichuev, R. (ONLINE), Sakibaev, K., Toichueva, A., Mamasharipov, K. OUR EXPERIENCE OF APPLYING THE RESULTS OF RESEARCH AND EVIDENCE-BASED MEDICINE FOR IMPROVING THE AWARENESS, ACHIEVING COMPLIANCE WITH SAFETY MEASURES AND IMPLEMENTING RECOMMENDATIONS BY THE POPULATION LIVING IN THE AREAS POLLUTED BY ORGANOCHLORINE PESTICIDES.	480
Block 15. POSTERS and SUBMITTED PAPERS	484
Cotillas, S., Santos, A., Lorenzo, D., Bahamonde, A., Palomo, E., Conte, L. REMEDIATION OF GROUNDWATER POLLUTED WITH HCHs USING SOLAR LIGHT IRRADIATION.	485
Salom, D., Fernández-Verdejo, D., Soder-Walz, J.M., Vicent, T., Marco-Urrea, E., Blánquez, P. COUPLING ELECTROKINETIC SOIL FLUSHING WITH BIOREMEDIATION FOR THE REMOVAL OF CHLORINATED BENZENES AND LINDANE IN GROUNDWATER.	489
Sala, M., Scaramozzino, P., Beccaloni, E., Scaini, F., D'Isidoro, A., Iudicone, G., Papa Caminiti, L.N., Rombolà, P., Neri, B. SNI SACCO RIVER VALLEY – CENTRAL ITALY: CHARACTERIZATION OF AGRICULTURAL AREAS.	492
Pardo, A., Bellas, R., Franco, S., Camiño, J.M. INTEGRAL INVESTIGATION ON THE COUNCIL OF O PORRIÑO, LOOKING FOR SOLUTIONS TO THE GREAT DISPERSION OF THE CONTAMINATION.	495
Fraile, J. M., Herrerías, C. I., Lumbreras, R., Mayoral, J. A., Salvatella, L. DISPOSAL OF PRODUCTION WASTE FROM LINDANE MANUFACTURING: COLLABORATION BETWEEN UNIVERSIDAD DE ZARAGOZA AND GOBIERNO DE ARAGÓN.	498

Fernández-Sanjulián, J., Chicaiza-Guerra, K.Y. PRELIMINARY STUDY OF THE BIOREMEDIATION CAPACITY OF HORSE AMENDMENT IN SOILS CONTAMINATED WITH HCHS.	
Amirova, Z. ASSESSMENT OF IN-SITE DIOXIN DEGRADATION IN WASTE, 1995-2021.	501
Navarro, I., De la Torre, A., Sanz, P., Martínez, M. A. ASSESSING PERSISTENT ORGANIC POLLUTANTS IN SPANISH AIR.	504
Chaos, Z., Méndez, A., Celeiro, M., García-Jares, C., Monterroso, C. IMPACT OF ORGANIC MATERIALS ON HEXACHLOROCYCLOHEXANE VOLATILIZATION FROM CONTAMINATED SOILS.	507
Perugini, M., Iannetta, A., Angelozzi, G., Coppola, L., Tait, S., Fabbrizi, E., Ciferri, L., La Rocca, C. PESTICIDE EXPOSURE AND PREMATURE IDIOPATHIC THELARCHE IN GIRLS: THE PEACH PROJECT.	508
Rodríguez-Arévalo, J., Castaño, S., Martín-Ruiz, M., Rodríguez-Abad, R., Asanza, E., Delgado, F., San Román, J. DESIGN AND EVALUATION OF TEST BY OXIDATIVE METHOD FOR DECONTAMINATION OF THE WALLS OF THE OLD INQUINOSA FACTORY.	512
CLOSING SESSION	516
REZOLUTION	522

Santos, A., Checa-Fernández, A., Domínguez, C.M., Martín-Sanz, J.P., Valverde-Asenjo, I., Quintana-Nieto, J.R.,

## INTRODUCTION

#### About the International HCH and Pesticides Forum

The International HCH and Pesticides Forum represents a platform for discussion between stakeholders of all kinds, working on implementation of projects related to POPs, obsolete pesticides and hazardous chemical waste. It acts as a catalyst in the exchange of information for the implementation of the Stockholm Convention and other chemicals- related multilateral environmental agreements, and the environmentally sound management of pesticides, pesticide waste and other chemicals, and has today developed into an important event for national as well as international decision-makers and stakeholders History of the International HCH and Pesticides Forum The first International HCH and Pesticides Forum took place in 1992 in Province of Overijssel - Zwolle in The Netherlands. Since 1992 the Forum has been organised 14 times and creates a platform for discussing the national and regional strategies, action plans and financial resources for elimination of obsolete pesticides with a special focus on the need for action.

**Forum Mission Statement** Obsolete pesticides are not only an environmental problem. Much more it stands in the way of socio-economic development, impacts both the quality of life resulting in human health problems and economic losses. The vision of the International HCH and Pesticides Forum is a world free of obsolete and POPs pesticides. The Forum mission is therefore continuously to ensure that the elimination of obsolete and POPs pesticides is on the global agenda by having bi- annual meetings for exchange of information and review of results.

**About IHPA** The International HCH & Pesticides Association (IHPA) is an independent and non-political and non-profit network of committed individuals that wants to draw international attention to the worldwide problems stemming from the production and use of HCH and other obsolete and POPs pesticides and its dangers for human health and the environment. Visit our website <a href="www.ihpa.info">www.ihpa.info</a> or contact IHPA, director John Vijgen, john.vijgen@ihpa.info</a> for more information. IHPA is now in its final stage to terminate its activities and is trying to transfer its mission and its activities to the regions in the European Union which are confronted with the Lindane problems.



Sustainable Event Certification: Control Union

# **HOST ORGANIZATIONS**









## **SPONSORS**





























### Support for participants to join the Forum

We would like to thank the following organizations for financing the travel/stay:

FAO for organizing the **GEF-FAO Project "Lifecycle management of pesticides and disposal of POPs pesticides in Central Asian Countries and Türkiye"**;

**DEKONTA**, especially Jan Vanek for enabling the Moldovan Delegation to join the Forum in Zaragoza;

The European project **END poiNTs** project and **GREEN TOX** – Group for Reproductive, Endocrine and Environmental Toxicology for supporting participants of their session.