

CONTENTS

Executive Summary	9
--------------------------------	----------

1. Introduction	16
------------------------------	-----------

1.1 Toxic additives in plastics	17
---------------------------------------	----

1.2 Brominated flame retardants (BFRs)	17
--	----

1.2.1 Polybrominated diphenyl ethers (PBDEs)	17
--	----

1.2.2 Hexabromocyclododecane (HBCD)	17
---	----

1.2.3 Novel BFRs (nBFRs)	18
--------------------------------	----

1.3 Short-chain chlorinated paraffins (SCCPs)	19
---	----

1.4 Per- and polyfluoroalkyl substances (PFASs)	19
---	----

1.4.1 PFOS	20
------------------	----

1.4.2 PFOA	20
------------------	----

1.4.3 PFHxS	20
-------------------	----

1.4.4 Other PFASs	21
-------------------------	----

1.4.4.1 PFDA	21
--------------------	----

1.4.4.2 PFDoA	21
---------------------	----

1.5 Dioxins (PCDD/Fs) and other unintentionally produced POPs	22
---	----

1.5.1 PCDD/Fs and dl-PCBs	22
---------------------------------	----

1.5.2 PeCB and HCB	22
--------------------------	----

1.5.3 HCBd	23
------------------	----

1.5.4 PBDD/Fs	23
---------------------	----

1.6 Waste exports from developed countries to Indonesia	24
---	----

1.6.1 Open burning of plastic waste	25
---	----

1.6.2 Waste to fuel operation(s)	25
--	----

1.7 Hazardous and medical waste incineration	26
--	----

1.8 Electronic waste	26
----------------------------	----

1.9 Aluminum dross recycling	27
------------------------------------	----

1.10 Use of ash residues from combustion processes	28
--	----

2 Sampling and analytical methods	30
--	-----------

3 Description of hotspots.....34

3.1 Banten	35
3.1.1 Tangerang Regency – plastic waste dumpsites and sorting places.....	35
3.1.2 Jakarta – supermarket, reference sample for eggs.....	35
3.2 East Java	36
3.2.1 Kendalsari, Jombang Regency - aluminum smelters.....	36
3.2.2 Bangun, Mojokerto Regency – plastic waste dumpsite and sorting place	39
3.2.3 Tropodo, Krian Sub-district, Sidoarjo Regency – tofu factories burning plastic waste	40
3.2.4 Lakardowo, Mojokerto Regency – hazardous waste incinerator	43
3.2.5 Sumber Beji spring, Panglungan Jombang, “Mbeji Forest” – reference site.....	45

4 Results and discussion.....46

4.1 Free-range chicken eggs	46
4.1.1 Dioxins (PCDD/Fs) and other unintentionally produced POPs	48
4.1.1.1 Dioxin-like activity of eggs measured by using bioassay analyses	48
4.1.1.2 Polychlorinated dibenzo-p-dioxins and dibenzofurans (PCDD/Fs) and dioxin-like polychlorinated biphenyls (dl-PCBs)	49

4.1.1.3 Dioxin congeners patterns.....	52
4.1.1.4 Hexachlorobenzene (HCB), pentachlorobenzene (PeCB) and hexachlorobutadiene (HCBD)	57
4.1.1.5 Polybrominated dibenzo-p-dioxins and dibenzofurans (PBDD/Fs)	57
4.1.2 Non-dioxin-like PCBs.....	58
4.1.3 Brominated flame retardants (BFRs)	59
4.1.4 Short-chain chlorinated paraffins (SCCPs).....	64
4.1.5 Per- and polyfluoroalkyl substances (PFASs)	64
4.1.6 Background levels of POPs in eggs.....	65
4.2 Dietary intake of selected POPs through consumption of free-range chicken eggs from Javanese hotspots	65
4.2.1 PCDD/Fs and dl-PCBs	67
4.2.2 PBDEs.....	68
4.2.3 PFOS	70
4.3 Ash, soil and other samples	70
4.4 POPs hotspots categories	72
4.4.1 Plastic waste yards	72
4.4.2 Aluminum smelters.....	76
4.4.3 Waste incineration	80
4.5 Use of residual ash from metallurgy and waste incineration.....	84

5 Conclusions.....89

5.1 Plastic waste dumpsites 89

5.2 E-waste 89

5.3 Waste incineration 89

5.4 Secondary aluminum smelters 90

5.5 Ash residues..... 90

5.6 POPs in Eggs..... 91

 5.6.1 UPOPs 91

 5.6.2 PBDEs and other BFRs..... 91

 5.6.3 PFASs..... 92

5.7 Tolerable daily intake (TDI) of selected POPs..... 92

6 Limitations of the study93

7 International Conventions’ measures95

7.1 Controls over plastic waste and e-waste
exports in the Basel Convention..... 95

7.2 Strengthening the Stockholm Convention
waste provisions..... 96

7.3 Implementation of the Stockholm Convention’s
provisions related to unintentionally produced POPs97

8 Recommendations.....99

Acknowledgements101

Abbreviations102

References104

Photos..... 123