



National Institute for Public Health
and the Environment
Ministry of Health, Welfare and Sport

PB(T)-score:
**Alle PBTs zijn gelijk,
maar sommige zijn
méér PBT dan
anderen.**

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RIVM PB-score: Een kwantitatieve maat voor PB-eigenschappen (op basis van QSARs)

- De RIVM PB-score - QSARs
- Erkende PBTs en POPs?
- Alternatieven voor POPs
→ Endosulfan
- QSARs vs Exp. data
→ HBCCD en twee alternatieven
- REACH prioritering
→ de EU iPBT lijst
- Toegevoegde waarde T score?



Welke stoffen zijn PBT?

- screening van grote lijsten, geen of weinig gegevens
→ QSAR schattingen
- bijvoorbeeld PBT-profiler (US-EPA)
- maar ook NL exercitie in verleden
- DK, DE, GB, ECHA ...
- BIOWIN model voorspelt Ready Biodegradable → not P
- KowWin voorspelt $\log Kow < 4.5$ → not B
- etc.

ZWART – WIT



of op zijn best





Waarom dan nóg een PB(T)-indicator?

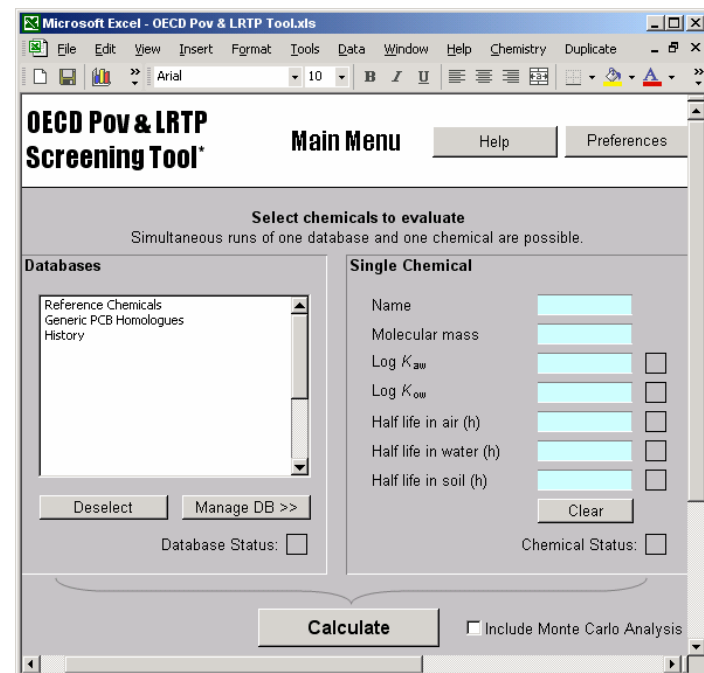
- niet: Is een stof PBT of niet?
- maar: Hóe PBT is een stof?
(vergeleken met anderen)





Persistence, P-score

- *OECD LRTP Tool: Overall Persistence (Pov)* as basis for P-score
 - › Highest value of $t_{1/2}$ (three emission scenarios) → good approximation of $t_{1/2}$ in the temporal remote state
- *BioWin3* → half-life in freshwater
- *Half-life in soil* = Halflife in Freshwater x 2
- *AOP* → atmospheric half-life
- *log Kow, log Kaw* and *MW*
- Distribution of $t_{1/2}$:transformation required:
- $P(\text{score}) = e^{(-\ln(2) * 180 / \text{LRTP-Pov})}$
 - **P-score ranges from 0-1**
 - **P-score 0.5 ~ $t_{1/2}=180$ days (vP)**





Bioaccumulation, B-score

- *Maximum BCF* from PBT guidance in REACH using $\log K_{ow}$ (KowWin)

$$\log BCF_{\max} = \frac{34.43}{2.93 \cdot (2 \cdot \pi)^{0.5}} \cdot e^{-0.5 \cdot \left(\frac{\log K_{ow} - 6.52}{2.93} \right)^2}$$

- Correction of max BCF by metabolism estimation (*BCFWin*)
 - *BMF* estimate for terrestrial food chain (mammals) using $\log K_{oa}$
 - *BAF* = metabolism corrected BCF * BMF
-
- Distribution BAF skewed; transformation required
 - Transformation: $B(\text{score}) = e^{(-\ln(2) * 5000 / \text{BAF})}$
-
- **B-score ranges from 0-1**
 - **B-score 0.5 ~ BAF=5000 (vB)**
 - **B-score 0.18 ~ BAF=2000 (B)**



PB-scores voor bestaande stoffen



- ~65.000 single structures

- Commercially relevant;

- EINECS
- INN/Pharmaceuticals
- Pesticiden
- Biociden

- Calculate scores:

P > 0.5 (t _{1/2} > 180 days):	16.646
B > 0.5 (BAF > 5000):	4.748
P > 0.5 AND B > 0.5 :	1.986



Resultaten: PB-score voor UNEP POPs

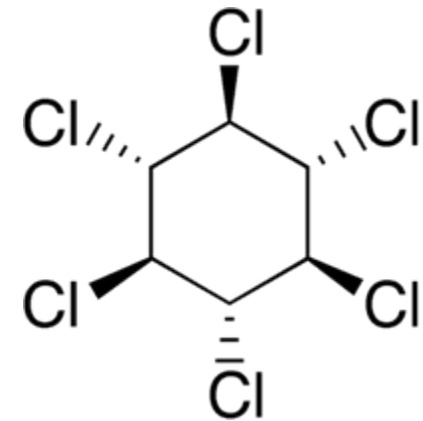
UNECE POP	CAS RN	Annex	PB-score	Rank / percentiel
Mirex	2385-85-5	A	1.98	2 / 99.99%
Chlordane	57-74-9	A	1.98	5 / 99.99%
Toxaphene	8001-35-2	A	1.96	17 / 99.97%
Aldrin	309-00-2	A	1.96	28 / 99.95%
Heptachlor	76-44-8	A	1.95	36 / 99.9%
Endrin	72-20-8	A	1.94	47 / 99.9%
Dieldrin	60-57-1	A	1.94	48 / 99.9%
DDT	50-29-3	A + B	1.92	82 / 99.8%
Chlordecone	143-50-0	A	1.85	163 / 99.7%
Hexachlorobenzene (HCB)	118-74-1	A + C	1.85	170 / 99.7%
Hexachlorocyclohexane (HCH)	608-73-1	B	1.67 (B-score 0.80)	484 / 99.3%
Hexabromobiphenyl	36355-01-8	A	1.06 (B-score 0.10)	3587 / 92.8%
Polychlorinated biphenyls (PCBs)	Mixture*	A + B	n.a.*	n.a.
Dioxins/Furans (PCDDs/PCDFs)	Mixture*	C	n.a.	n.a.



Resultaten: voorbeeld HCH

HexachloroCycloHexane; HCH

- formally does not meet the screening criteria!
 - > $\log K_{ow}$ < 4.5
 - > BCF est. (BCFWin) < 5000
- In RIVM screening:
 - > P-score 0.87,
 - > **B-score 0.80**
 - > PB-score 1.67
 - > **high B-score: $\log K_{oa}$ is taken into account**
- Ranks #484 of the 65.000 calculated substances





PB-score Endosulfan vs. alternatieven (UNEP)

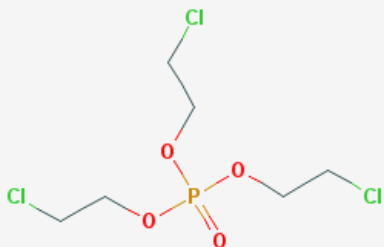
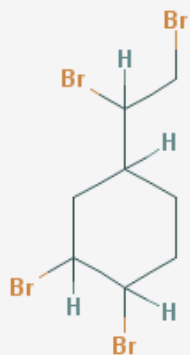
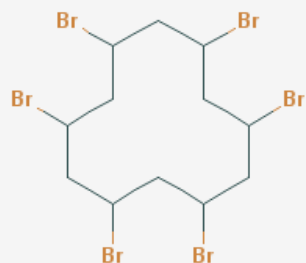
Substance	CAS no.	P	B	P+B
endosulfan	115297	0.87	0.47	1.34
spinosad	168316958	0,91	0,35	1,26
fenbutatin oxide	13356086	1,00	0,00	1,00
teflubenzuron	83121180	0,99	0,00	0,99
fosalone	2310170	0,56	0,41	0,97
indoxycarb	173584446	0,95	0,00	0,95
azadirachtin	11141176	0,94	0,00	0,94
diflubenzuron	35367385	0,88	0,01	0,89
deltamethrin	52918635	0,75	0,13	0,87
methoxyfenozone	161050584	0,76	0,00	0,76
fenoxy carb	79127803	0,49	0,00	0,49
pirimicarb	23103982	0,44	0,00	0,44
imidacloprid	138261413	0,41	0,00	0,41
codlemone	33956499	0,02	0,34	0,35



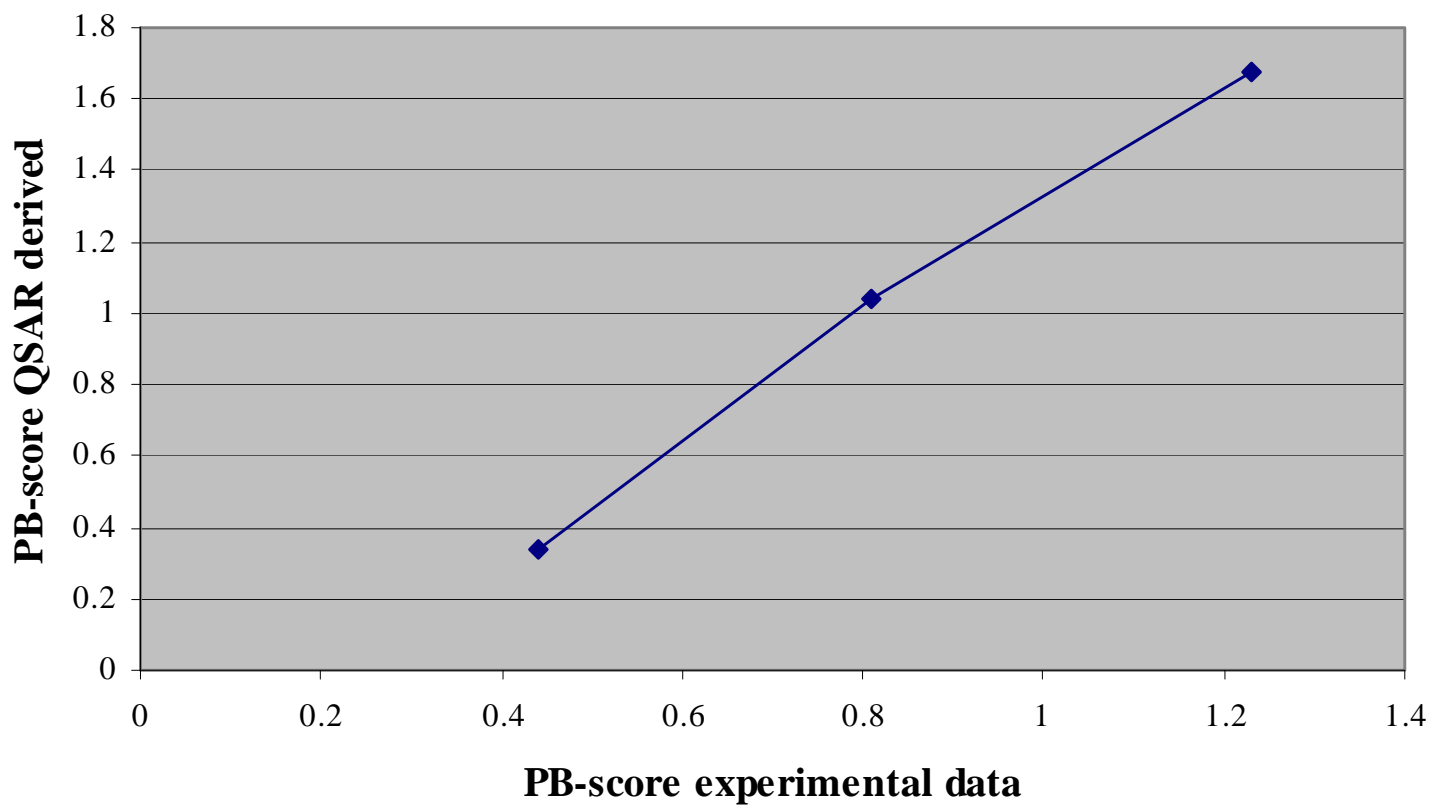
... acetamiprid, emamectin benzoate, flonicamid, spirotetramat, thiacloprid



PB-score vanuit experimentele data



PB-scores for HBCDD, TBECH en TCEP





NL PBT prioritieits list – EU iPBT working group

- 4938 substances/EC numbers on REACH reg.list juli 2011, of which
- 1857 substances had a pre-calc'd PB-score
- The majority of the CAS-numbers without a PB-score are mixtures, technical products, reaction products or UVCBs
- Of the 1857 substances with a PB score there are:
 - 39 vPvB (score $P > 0.5$ en $B > 0.5$), and additionally
 - 49 PB(T) (score $P > 0.35$ en $B > 0.18$)
 - a total of 88 potential PB(T) kandidates
- Prioritizing 200+ combined DE, ECHA, UK and NL list using PB-score.

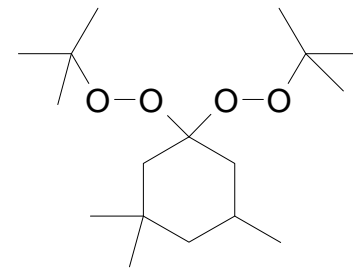


2 substances prioritized by NL, DE, UK and ECHA

- **TRIGONOX 29/40,**
P=0.86, B=0.97;

ECHA predicted P and B
DE priority
UK priority

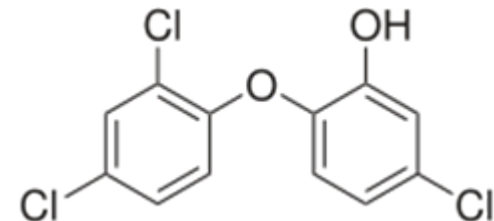
crosslinking of natural and synthetic rubbers as well as thermoplastic olefins



- **Triclosan,**
P=0.75, B=0.43;

ECHA predicted P, no B prediction
DE priority
UK priority

antibacterial and antifungal agent,
used in many consumer products



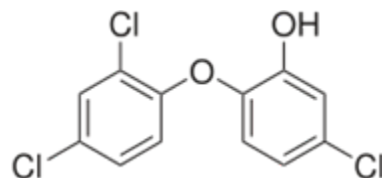


T-score / T-flag; hebben we dat nodig?

- Calculated aquatic Toxicity < 0.1 mg/l (ECOSAR or DK-QSAR)
OR
- DK advisory Self-classification C or M or R

- flagged for T?

- ECOSAR < 0.1 mg/l
- DK-QSAR < 0.1 mg/l
- DK C&L

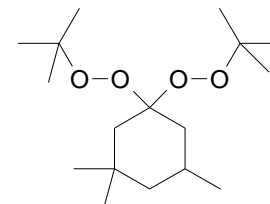


TRICLOSAN:

YES

NO

FALSE



TRIGONOX:

NO

YES (algae)

FALSE

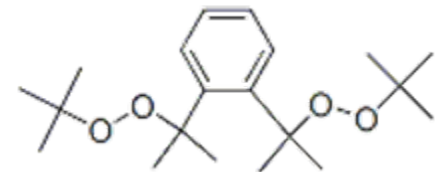


Examples (P and B > 0.5) from the REACH reg.list

- BIPB, P=0.86, B=0.97;

T-flag TRUE (ECOSAR)

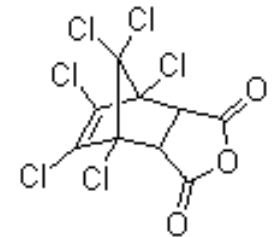
crosslinking agent in plastics, a vulcanizing agent in rubber, such as CPE, EPDM, EVA, silicone rubber, butyl-acrylonitrile rubber.



- Chlorendic anhydride, P=0.97, B=0.76;

T-flag TRUE

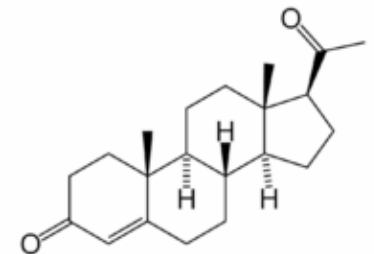
fire and corrosion resistances and UV stability for alkyd resins, polyurethanes, polyesters and epoxy resins



- Progesterone, P=0.70, B=0.50;

T-flag TRUE

major naturally occurring human progestogen





RIVM rapport



- **RIVM rapport:
Identifying potential POP and
PBT substances.**
Development of a new
Persistence/Bioaccumulation-score
RIVM Report 601356001/2011
- Rapport beschikbaar op:
<http://www.rivm.nl/bibliotheek/rapporten/601356001.pdf>
- of Google "Rorije POP PBT"
- Papieren versie hier aanwezig
- Publicatie in de maak