Primary CB-28 emission and residues in China

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1. Introduction

Polychlorinated biphenyls (PCBs) were manufactured in China from 1965 until 1974 when they were banned. Over this period, approximately 10000 t of PCBs were produced, of which 9000 t as trichlorobiphenyl, known as no. 1 PCB, and 1000 t as pentachlorobiphenyl, no. 2 PCB [(1,2)]. Trichlorobiphenyl was used primarily in power transformers and capacitors, while pentachlorobiphenyl was used mainly as a paint additive [(2)].

This paper studies the primary emissions and soil residues of CB-28 in China due to the use of PCBs in 1965-1974.

2. Usage inventories

Figure 1 presents gridded PCB usage inventories in China with 1/6 °×1/4 °latatude/longitude resolution for 1965-1974. The total PCB usage was 10,000 t[(3)], among which, the usage of CB-28 was around 370 t, approximately 3.7% of total PCB usage in the country.

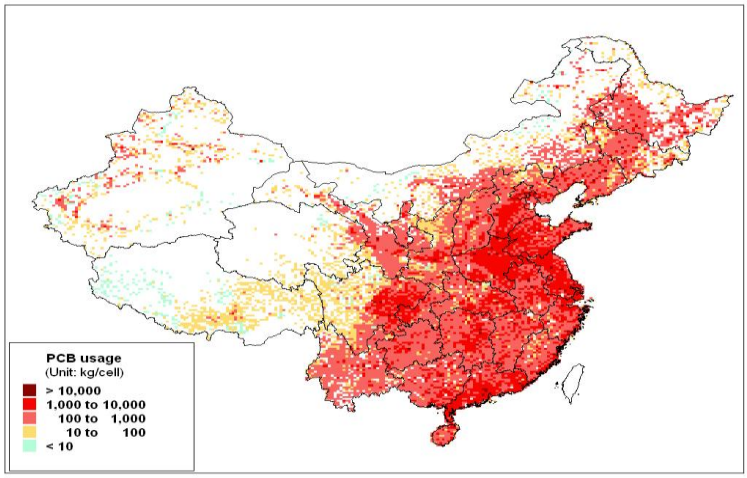


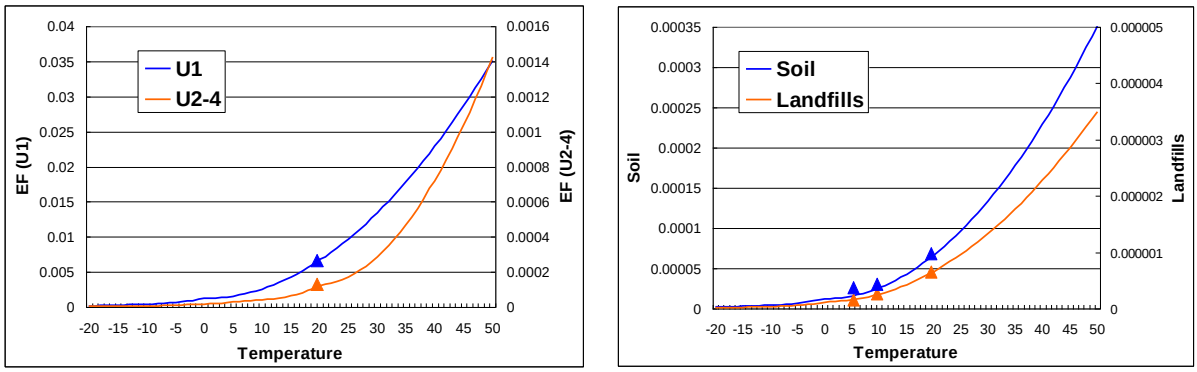
Figure 1. Gridded PCB annual usage inventory in China with 1/6 °×1/4 °latitude/longitude resolution for 1965-1974. The total usage was 10,000 t[(3)].

3. Model

A mass balance model has been developed to estimate the primary emissions and residues for PCB in China. The methodology for this model was mainly from Breivik et al. [(4,5)].

4. Parameters

The major parameters used in our model to compile emission/residue of CB-28 are emission factors and degradation factors. **Figure 2** presents emission factors of CB-28 for different categories and those in soils and landfills, which are functions of temperature, and **Figure 3** presents degradation factors in soils and landfills as functions of temperature.



(a) (b)

Fig. 2 Emission factors as functions of temperature for (a) different use categories and (b) accident to spill in soil and disposal in landfills (The data presented by tri-angles are from[(5)]).

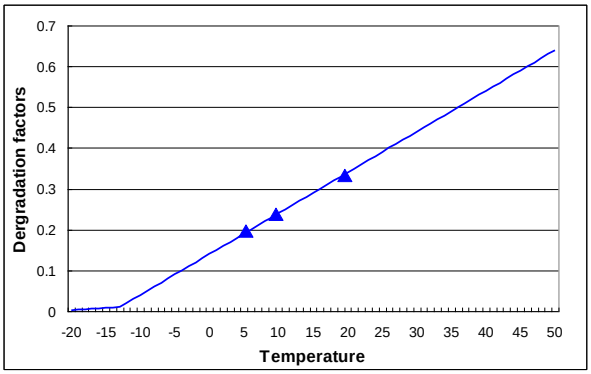
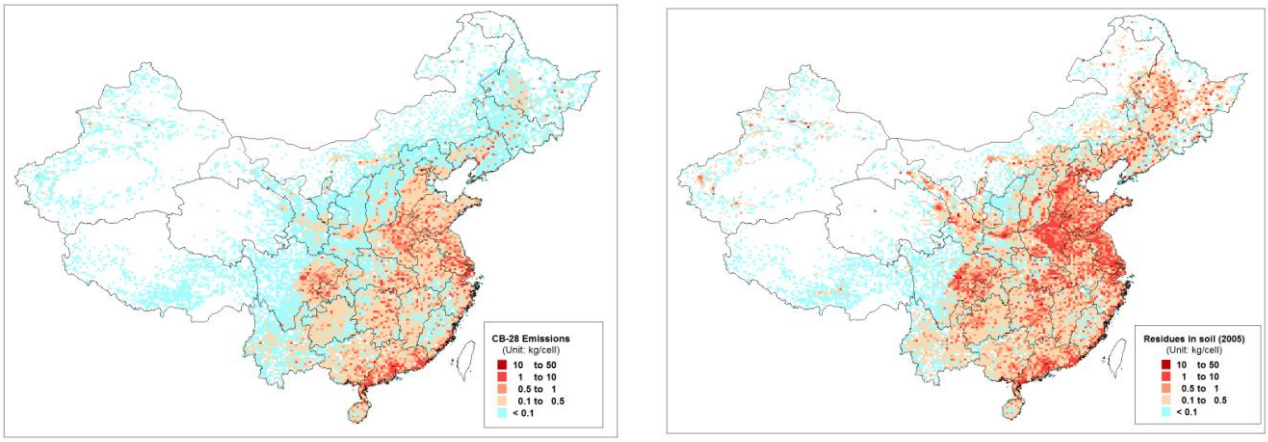


Fig. 4 Degradation factors in soils and landfills as functions of temperature (The data presented by tri-angles are from[(5)]).

5. Results

5.1 Emission/residue inventories

Primary PCB emission to air and residue in soil inventories with 1/6 º×1/4 º latitude/longitude resolution are shown in **Fig. 5**. The total emission was 2.9 t, 0.8% of total PCB-28 usage, and the total soil residues of CB-28 in Chinese soil was 6.1 t in 2005. It shows that higher emissions and residues were in the east and southeast of China, and lower in the west and north of China, corresponding to the developing status in these areas.



(a) Emission (b) Residue in soil

Figure 5. Gridded CB-28 inventories for (a) total emissions for 1965-2010 and (b) soil residue in 2005 in China with 1/6 º×1/4 º latitude/longitude resolution.

5.2. Temporal trends

Figure 6 depicts temporal trends of emission to air and residue in soil for CB-28 from 1965 to 2010, which was divided into 4 periods, namely, starting, in use, disposing, and ending periods. It shows that, although the production of PCB in China was stopped in 1974, increases of both emissions and residues for CB-28 (for other PCB congeners too) happened after ~1990, corresponding to the year when the power transformers and capacities containing PCBs were dismantled and the equipments were stored or treated.

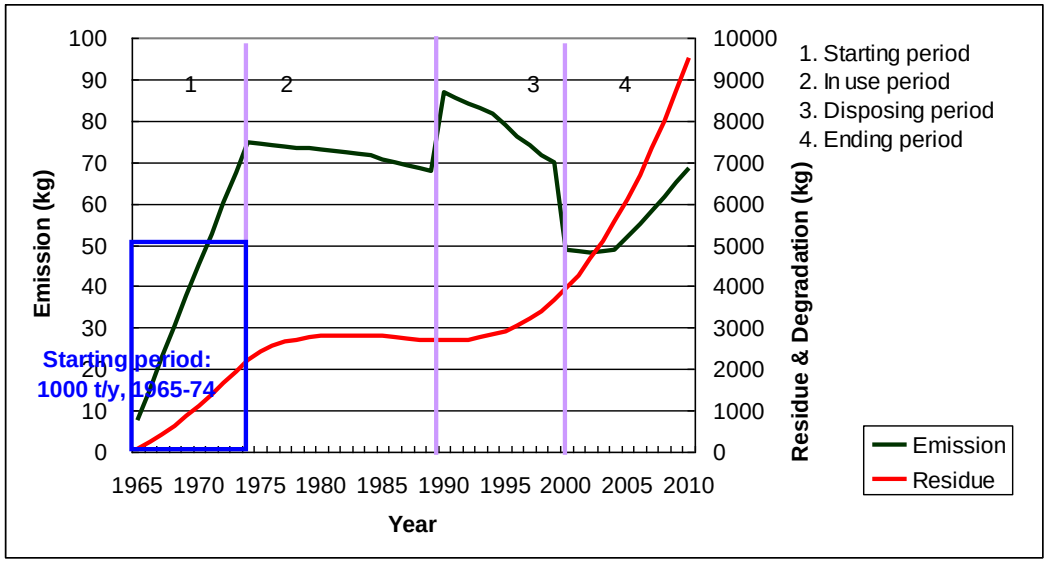


Figure 6. Temporal trends of emission to air and residues in soil for CB-28 for 1965-2010. The total emission was 2.9 t, 0.8% of total PCB-28 usage.

5.3. Comparison with data by Breivik[5].

Figure 7 shows the emission of CB-28 in China from 1960 to 2010 given by Breivik[5], indicating the highest emissions happened in 1974, within the PCB starting period (1960-1979) in China[6] used by the authors (see Figure 7).

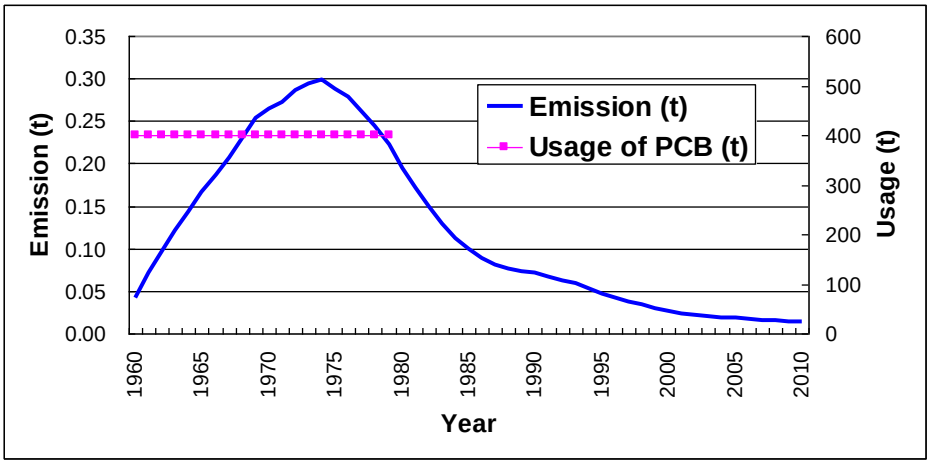


Figure 7. Temporal trends of emission to air for CB-28 for 1960-2010 from Breivik[5]. The total emission was 6.1 t, 2.5% of total PCB-28 usage. The annual usage of PCB (400 t) from 1960 to 1979[6] is also given.

6. Discussions

Great difference was observed between the two emission inventories for Chinese CB-28 compiled by us and Breivik et al. [5]. A further study is planned to evaluate these two sets of inventories.

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References

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