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A MODERN WAY TO TEACH ENVIRONMENTAL PROTECTION: EXAMINING STRUCTURE, PROPERTIES, UTILIZATIONS AND HYGIENE IMPLICATIONS CORRESPONDING TO PCB'S PRODUCTS PRESENCE IN ECONOMY

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abstract: In this paper plan of the lesson dedicated to examination of the structure, properties, utilizations and industrial hygiene implications corresponding to PCB's products presence in economy is realized. This lesson is addressed to third year students of Environmental chemistry section as material for the compulsory course: Relationships Structure Properties Toxicity of Industrial Pollutants. This action follows development of the comparative and selective students thinking abilities.

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General considerations

Polychlorobiphenyls (PCB's) are considered ones from the most environmentally dangerous chemicals [1,2] from many reasons: low biodegradability, possibility of bioaccumulation, increased toxicity, in rapport with parent molecules, of the intermediars formed during their lent degradation. PCB's can induce cancer and different malformations to exposed workers by inhalation or skin absorption [3,4]. For these reasons PCB's are considered as contaminants having low exposure limits [4-6] and its production at macro-industrial scale is interdicted in Japan from 1970, in US from 1977, in France from 1983, in Romania from 2000 [2].

Because these pollutants are present in complexes matrices in air, water, soil in concentration of micrograms or nanograms per liter, a high sensibility of used methods for their analysis is necessary [3,7,8]. In this work we propose a modern way to teach basic elements of environmental protection, showing how industrial hygiene implications are correlated with structure, properties, utilisations of PCB's products in economy. The proposed lesson designed at university level, is addressed to students of Environmental Chemistry section from Faculty of Chemistry at the Bucharest University.

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The **instructive-formative scope** of the proposed lesson follows to introduce, explain and apply the notions correlated with structural formula, isomery, properties, utilizations and consequences of PCB's spreading in the environment.

The **educational scope** follows development of the comparative and selective students thinking abilities.

Lesson will be realised as classical presentation, assisted by video-projections of the illustrative material, selected for argumentation.

Introduction of the lesson

Polychlorobiphenyls, abbreviated as PCB's, can be described by general structural formula.

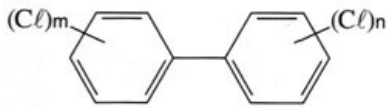

Fig. 1 *General PCB's structural formula.*

Different PCB's have a variable number of the chlorine atoms (maximum 10). Therefore are 209 PCB's in all. Only 14 of those posses a *planar structure*.

Every isomer has different *physical-chemical characteristics* and *toxicity.*

Development of the lesson

Concerning physical PCB's-chemical characteristics we must mention that PCB's are oil form liquids with higher density and viscosity and very low electrical conductivity, associated with a high thermal stability. From this results PCB's features described in the comparative Table 1

Table 1 Features of PCB's.

No	Good	Bad
1	Insulation	Hard to biodegrade
2	Hard to volatilize	Remain in environment
3	Hard to burn	Accumulate in fat tissues of living things
4	Insoluble in water by soluble in organic solvents	Suspected carcinogens and have various toxicities

From the good PCB's features results their various utilizations systematized in Table 2.

Various toxicity of PCB's is the consequence of their bad features.

When people are exposed to a lot of PCB's at one time, such as in accidents, a rush will appear on the skin immediately. In case of very high concentration exposure effects include [4]:

- pigmentation changes,
- chlorine acne,
- irritations of mucous membranes,
- increased blood triglycerides,

– deterioration of the liver and disruption of the immune system.

Table 2 The uses of PCB's.

No	Uses	Examples of products and the places where they are used
1	Insulating oil for transformers and for capacitors	Transformers for hospitals, rail road vehicles, vessels Capacitors for fluorescents and mercury lights, household electrical appliances
2	Heat transfer medium (heating or cooling)	Heating and cooling agent in various chemical, food, synthetic resin industry
3	Lubricating oil	Lubricating oil for high temperature, fluid for vacuum pump oil, etc
4	Plasticizer for insulation/ resistant to flame	Covering/insulating tape, mixed to polyester resin

Concerning PCB's congeners toxicity [8] the coplanar PCB's posses an increased toxicity by comparison with their non planar isomers. This fact is due to their similarity with structure, of one from the most toxic known compounds, tetrachlordioxine(TCD) as results from Fig. 2.

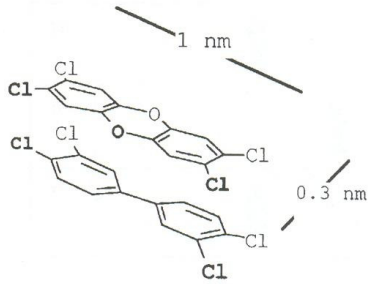

Fig. 2 *Structural similarity of a planar PCB with TCD [7].*

For these reasons production of PCB's at macro-industrial scale is interdicted as was indicated in introduction of the lesson.

Why PCB's pollution continues?

– Slow progress in elimination of PCB's by interdiction of their production at macro-industrial scale

– A source of pollution is products in use

– Waste dumping sites can also be polluting sources

Knowing these facts we must understand better *the needed measures for protection of environment:*

– very good design and execution of the mechanical closed installations (transformers, capacitors) which use PCB's in different scopes [8] ,

– a preventive design and policy of PCB's productions laboratories and of the dumping sites,

- improving of methods for PCB's dosage and analysis using high selective techniques of complex matrices samples, with provenience from various environment compartments.
- change in the educational system by improving curricula to develop *knowledge based society*.

Conclusions

In this lesson:

- were introduced and systematically applied the notions correlated with structure, isomers, properties, toxicity and PCB's utilizations in economy.
- have been demonstrated reasons for PCB's producing at macro-industrial scale interdiction and necessary procedures for limiting their world wide pollution.

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