

Tomsk Polytechnic University

ECOLOGICAL RISK ASSESSMENT FROM CHEMICAL EXPOSURE

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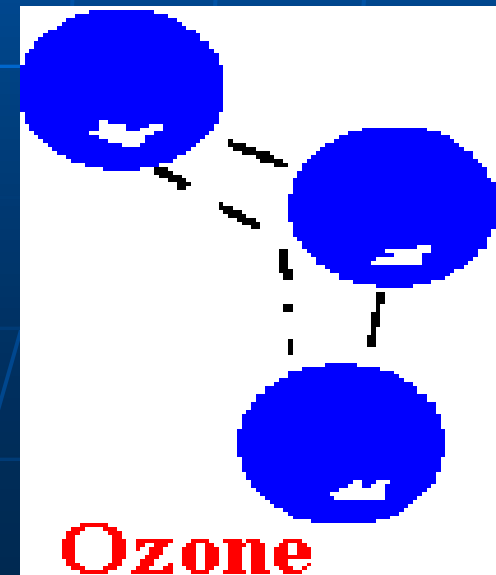
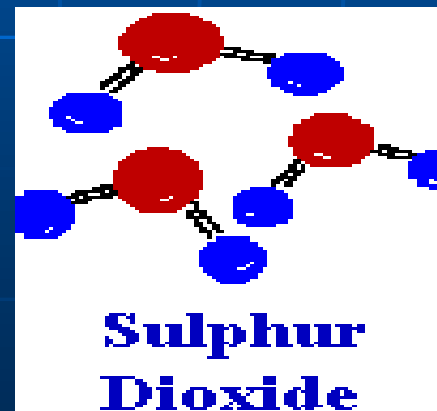
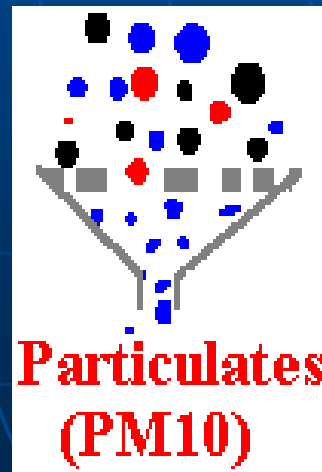
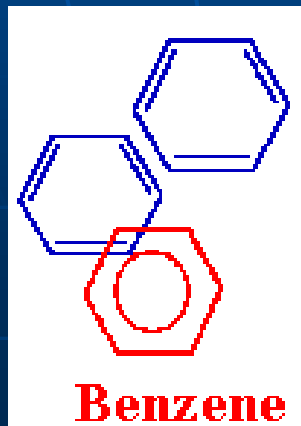
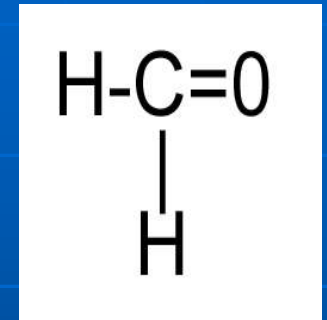
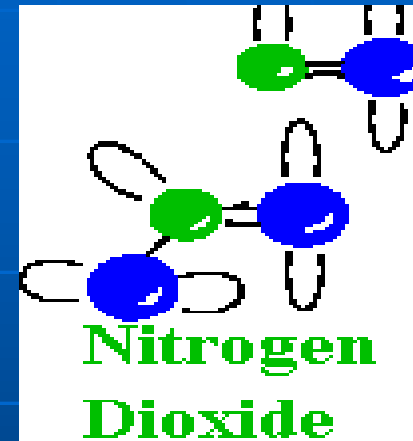
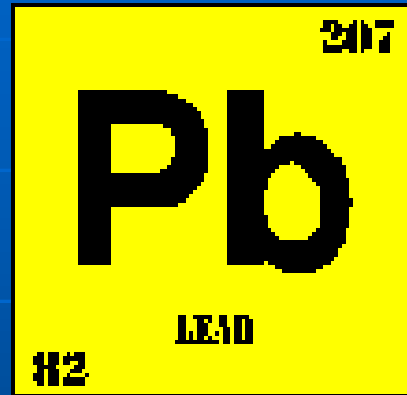
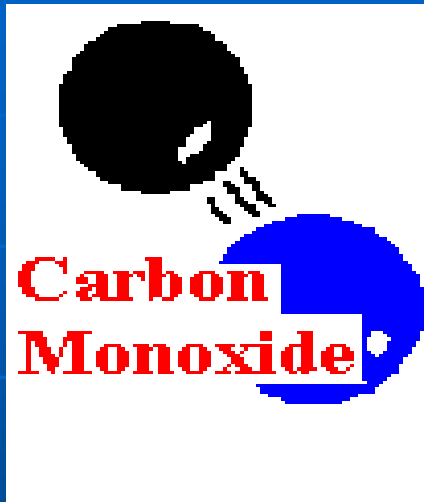
- INTRODUCTION
- THE CHEMICAL POLLUTANTS OF ATMOSPHERIC AIR
- METODOLOGY OF HUMAN HEALTH RISK ASSESSMENT FROM EXPOSURE OF CHEMICALS
- ASSESSMENT OF HUMAN HEALTH RISK FOR THE POPULATION OF TOMSK CAUSED BY CHEMICAL POLLUTANTS OF THE ATMOSPHERE
- CONCLUSION

Key Words

hazard identification;
dose-response assessment;
exposure assessment;
risk characterization
chemical pollution
environmental risk
risk assessment



THE CHEMICAL POLLUTANTS OF ATMOSPHERIC AIR



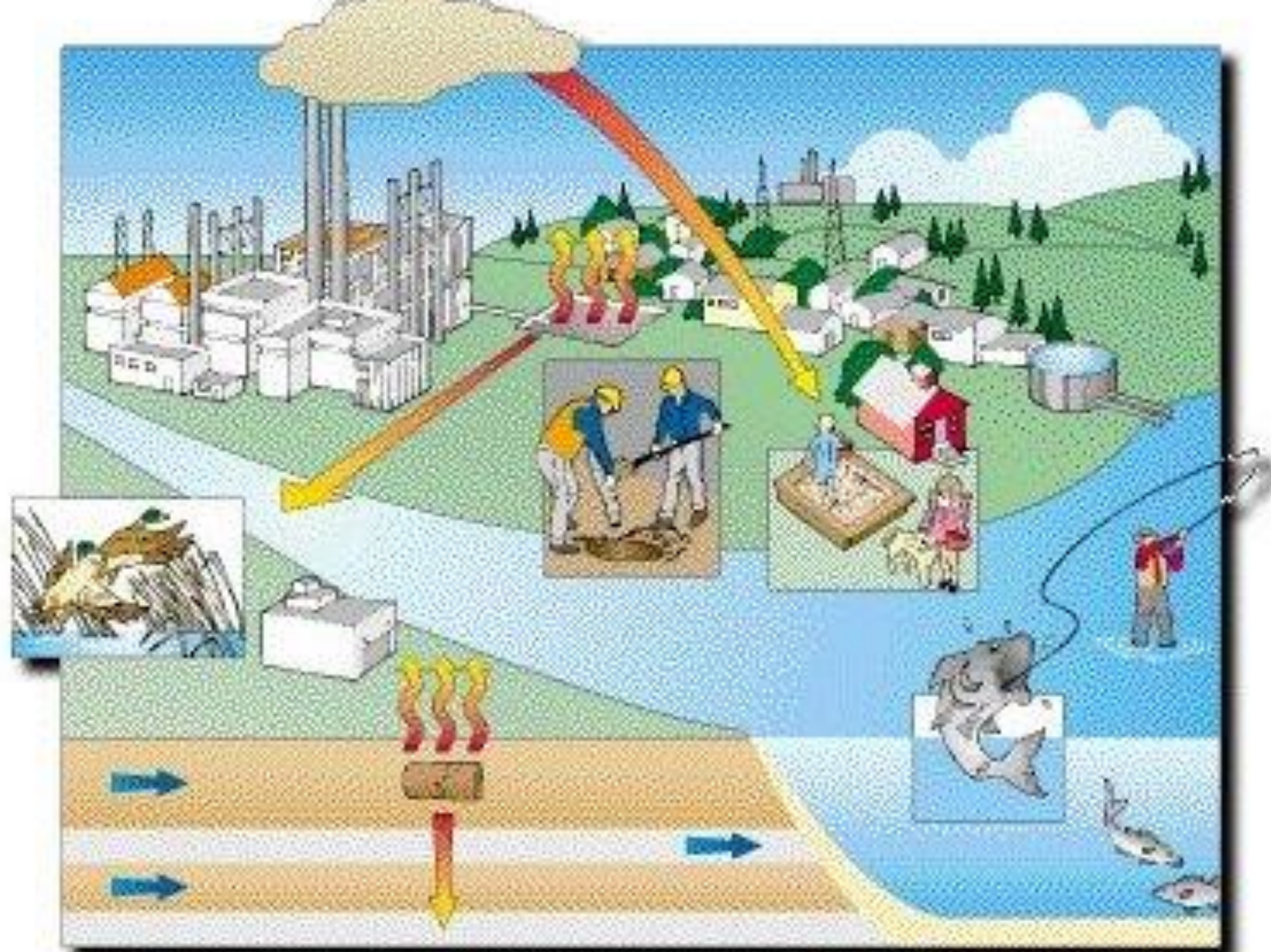
The industrial processes at Tomsk Petrochemical Plant “Tomskneftekhim”



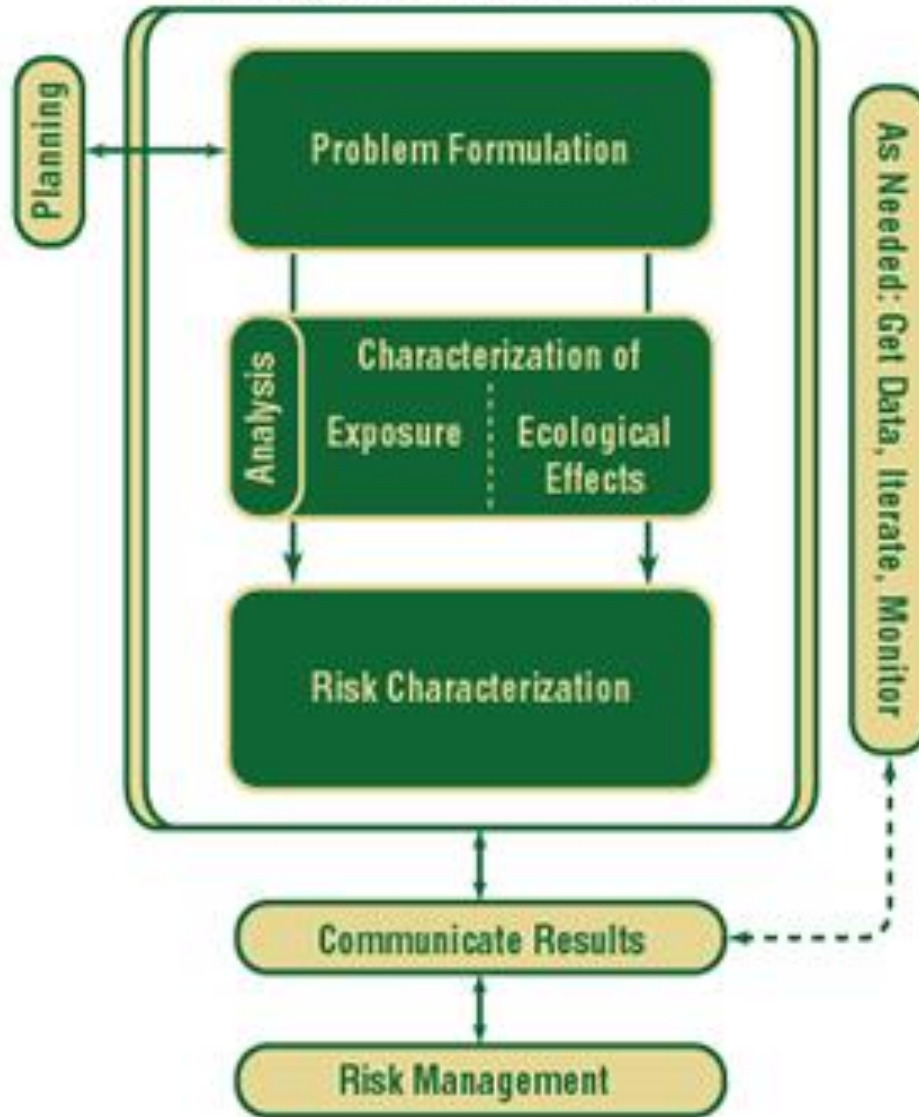
Formaldehyde production

- Industrially formaldehyde is produced by oxidative methanol dehydrogenation.
- · in vapour phase on silver catalyst at 680-720°C. Methanol conversion is 97-98%;
- · on silver catalyst at 600-650°C with methanol conversion 77-87%. Unreacted methanol is recycled;
- · with excess of air on iron-molibdenum-tungsten oxide catalyst at 250-400°C. Methanol conversion is 98-99%;





Ecological Risk Assessment



METODOLOGY OF HUMAN HEALTH RISK ASSESSMENT FROM EXPOSURE OF CHEMICALS

1. Hazard identification
(problem formulation);
2. Dose-response assessment;
3. Exposure assessment;
4. Risk characterization.
5. Risk Management

1. Hazard identification (problem formulation)

- assembling and summarizing data, definition of the environmental values to be protected, description of hypothesized relationships between the pollutant and the receptor, development of plan

2. Dose-response analysis

- technical evaluation of data on exposure and effect, figuring out whether and how the dose of a contaminant will affect human health and environment.

3 Exposure assessment

- evaluation of intensity, duration, and frequency of human exposure to pollutants or toxins.

4. Risk characterization

- determination of the percentage of population at risk and probability of an individual suffering ill effects.

5. Risk management

- Making scientific conclusion and decision on actions for minimizing health problems related to exposure to pollutants or toxins.

Calculations

LADD - Living Average Daily Dose

- $LADD = [C \times CR \times ED \times EF] / [BW \times AT \times 365]$
- , mg/kgxday,
- C – the average concentration of the chemical substances, affecting during the exposure, mg/m³;
- CR- Contact Rate, for inhalation affect – inspiratory rate, m³/day;
- ED- Exposure Duration, years;
- EF -Exposure Frequency, day/year;
- BW – Body Weight, kg;
- AT - Average Time, or average life expectancy, years

CR – Cancerogeneous Risk

$CR = 1 - \exp(-SF \times LADD)$
CR – Cancerogeneous Risk,
SF - Slope Factor, or Unit Risk,
(mg/kgxday)⁻¹, reference date are
used;

Index Damage- noncancerogeneous Risk

- $HQ = LADD/RfD$
- HQ - Index Damage
- LADD - Living Average Daily Dose,
mg/kgxday,
- RfD – Referent (harmless) Dose,
mg/kgxday, reference data are used.

RISK ASSISTANT

Screenshot

Выберите вещества

Поиск:

Вывести все синонимы

Текущий список веществ

Контекстное вхождение

- в начале названия
- в любой части названия

CAS

88-72-2

Вещества, найденные в Базе данных

Выделите одно или несколько веществ

- 59-50-7/2-ХЛОР-5-ГИДРОКСИТОЛУОЛ
- 88-17-5/альфа,альфа,альфа-ТРИФТОР-о-ТОЛУИДИН
- 88-72-2/2-НИТРОТОЛУОЛ
- 88-72-2/о-НИТРОТОЛУОЛ
- 91-08-7/2,6-ТОЛУОЛ ДИИЗОЦИАНАТ
- 95-49-8/о-ХЛОРТОЛУОЛ
- 95-53-4/О-ТОЛУИДИН
- 95-68-1/2-МЕТИЛ-п-ТОЛУИДИН
- 95-68-1/4-АМИНО-3-МЕТИЛТОЛУОЛ
- 95-68-1/4-МЕТИЛ-о-ТОЛУИДИН
- 95-69-2/2-АМИНО-5-ХЛОРТОЛУОЛ

Ближайш

RISK ASSISTANT

Screenshot

Химические данные

Искать:

Среда:

Единицы измерения:

	CAS	Название	Концентрация
1			
2			
3			
4			
5			
6			
7			
8			
9			

Сценарии экспозиции

Группа населения:

Питьевая вода
Принятие душа
Воздух в помещении
Наружный воздух
Овощи
Фрукты
Молочные продукты
Мясо

Токсикологические данные

Отчет

The interface of Risk Assistant:

The screenshot displays the Risk Assistant software interface, divided into several sections. Red circles and numbers (1-8) highlight specific elements:

- 1:** Search input field labeled "Искать:".
- 2:** Table with columns "CAS", "Название", and "Концентрация".
- 3:** Environment selection dropdown menu labeled "Среда:" with "Грунтовая вода" selected.
- 4:** Measurement units label "Единицы измерения: ug/l".
- 5:** Population group dropdown menu labeled "Группа населения:" with "Avg American(RME)" selected.
- 6:** Exposure scenario list on the right side, including "Грунтовая вода", "Питьевая вода", "Принятие душа", "Воздух в помещении", "Наружный воздух", "Овощи", "Фрукты", "Молочные продукты", and "Мясо".
- 7:** Toxicological data dropdown menu labeled "Токсикологические данные:" with "IRIS & HEAST(05/30/95&07/14/95)" selected.
- 8:** Report type dropdown menu labeled "Отчет:" with "Стандартный" selected.

Buttons for "Поиск", "Выбор веществ", "Выбор концентраций", "Выбор вредных веществ", "По выбору", and "Стандартный" are also visible.

CAS	Название	Концентрация
1		
2		
3		
4		
5		
6		
7		
8		
9		

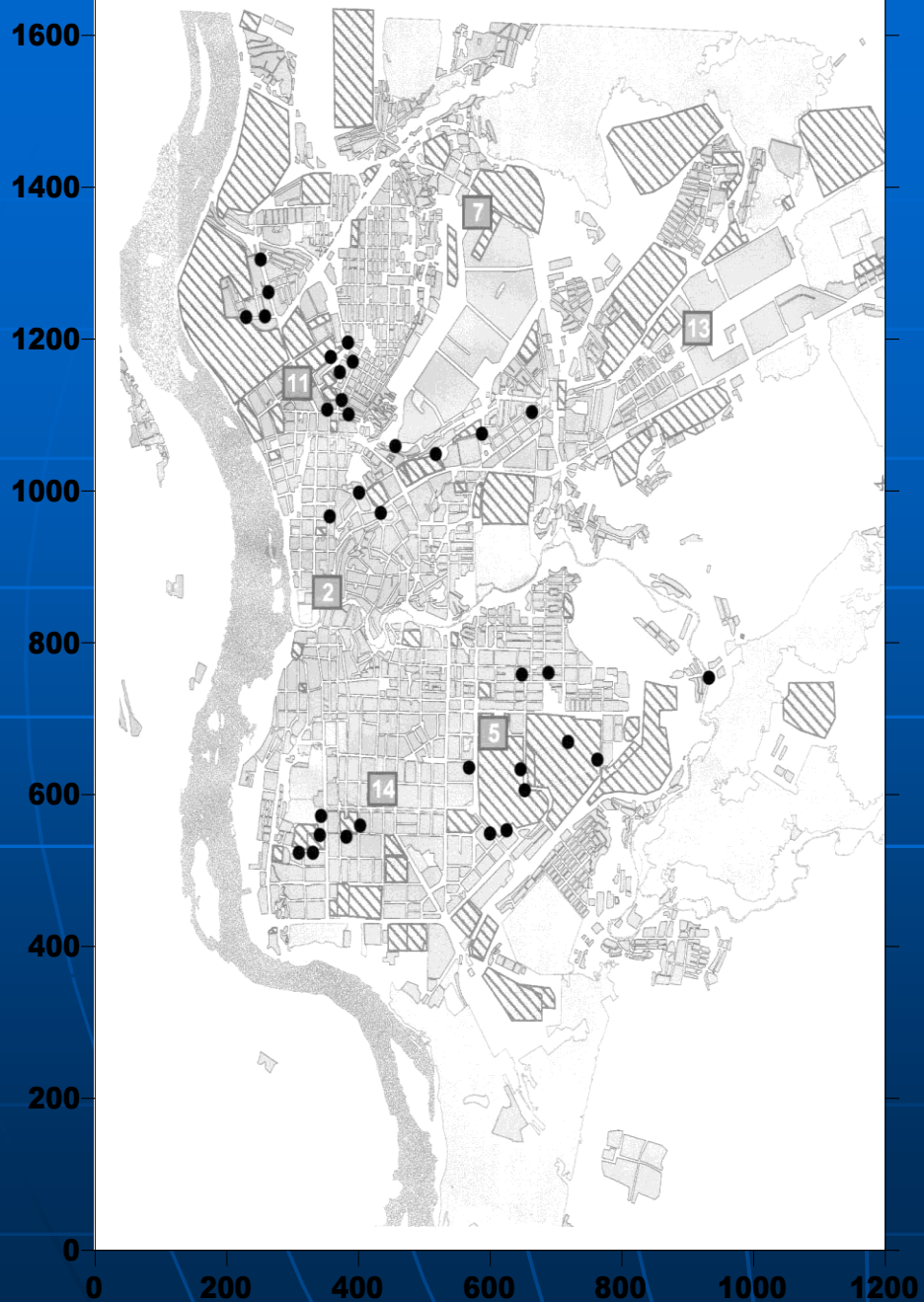
1. Find the element in the database. Not all elements come in their basic form, such as thorium, which exists as ThO_2 .
2. The element found in (1) will be added. Furthermore the concentration of this element should be added in the last box.
3. This step we should choose were to look for the elements, in our case, soil.
4. The group of selected people and thus their rules and laws.
5. Again where to look for the elements.
6. How do elements enter the human body, in our case, dust inhalation.
7. Chosen database.
8. Button to start standard risk assessment.

Comparaison with standards

Risk level	R_{ind}	HQ	
Extremely high	10^{-1}	More than 5	Unacceptable neither for the population, nor for professionals. Other actions for risk decrease
High	$10^{-1}-10^{-3}$		Carrying out of emergency improving and other actions for risk decrease is necessary
Average	$10^{-3}-10^{-4}$	1 - 5	Acceptable for professionals and unacceptable for the population as a whole; occurrence of such risk demands planned improving actions in the conditions of the inhabited sites
Low	$10^{-4}-10^{-5}$	0,1 - 1	Demands of constant control
	$10^{-5}-10^{-6}$		Corresponds to a zone of conditionally (admissible) risk; at this level the majority of hygienic standards recommended by the international organizations for the population as a whole is established
Minimum	Less than 10^{-6}	Less than 0,1	Corresponds to one additional case of serious disease or death per 1 million persons suffered from the effect. Such risks are perceived by people as negligibly small, do not differ from usual, daily ones. Do not demand for additional measures in their decrease, are subject to only the periodic control

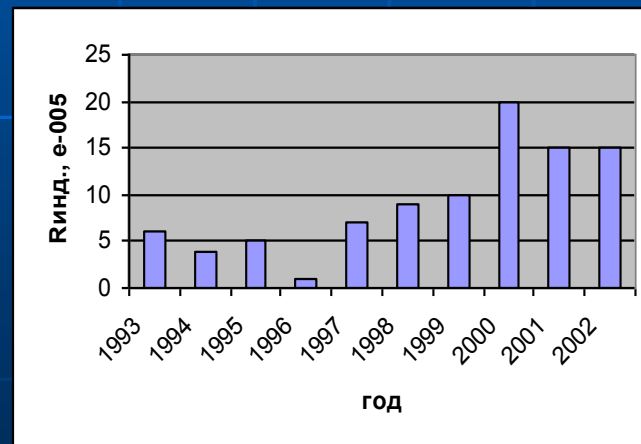
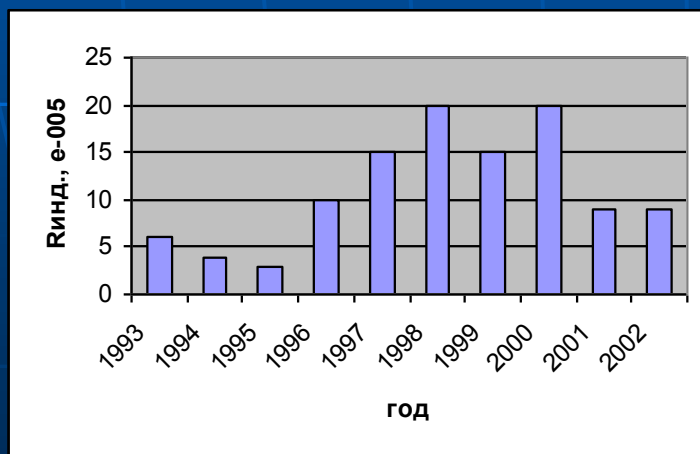
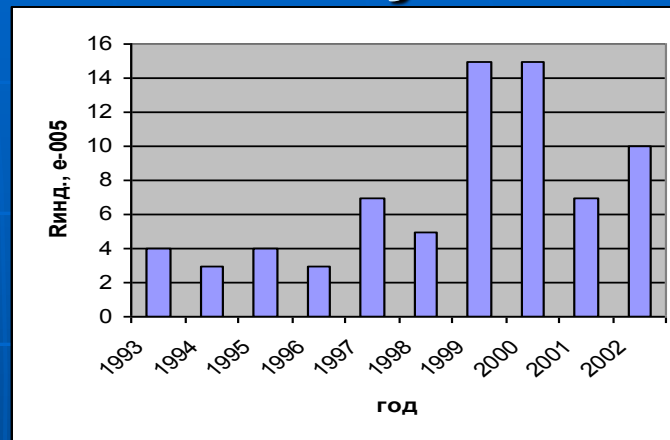
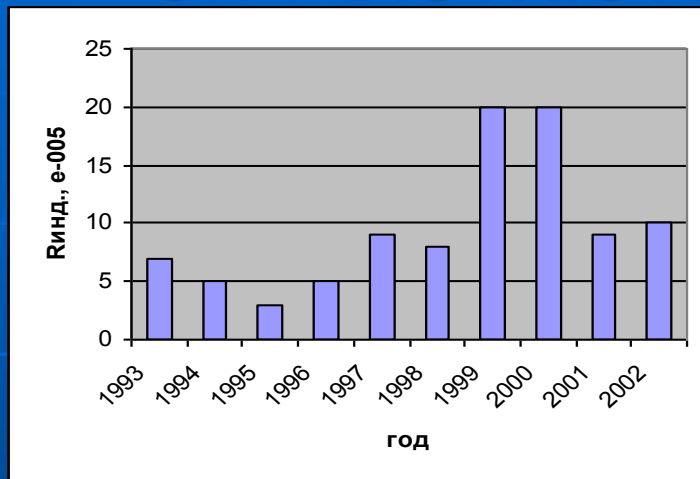
ASSESSMENT OF HUMAN HEALTH RISK FOR THE POPULATION OF TOMSK CAUSED BY CHEMICAL POLLUTANTS OF THE ATMOSPHERE

**The assessments of exposure to
pollutants, controlled by the
State Weather Services (Tomsk
Region) in atmosphere for
current contamination level are
performed**



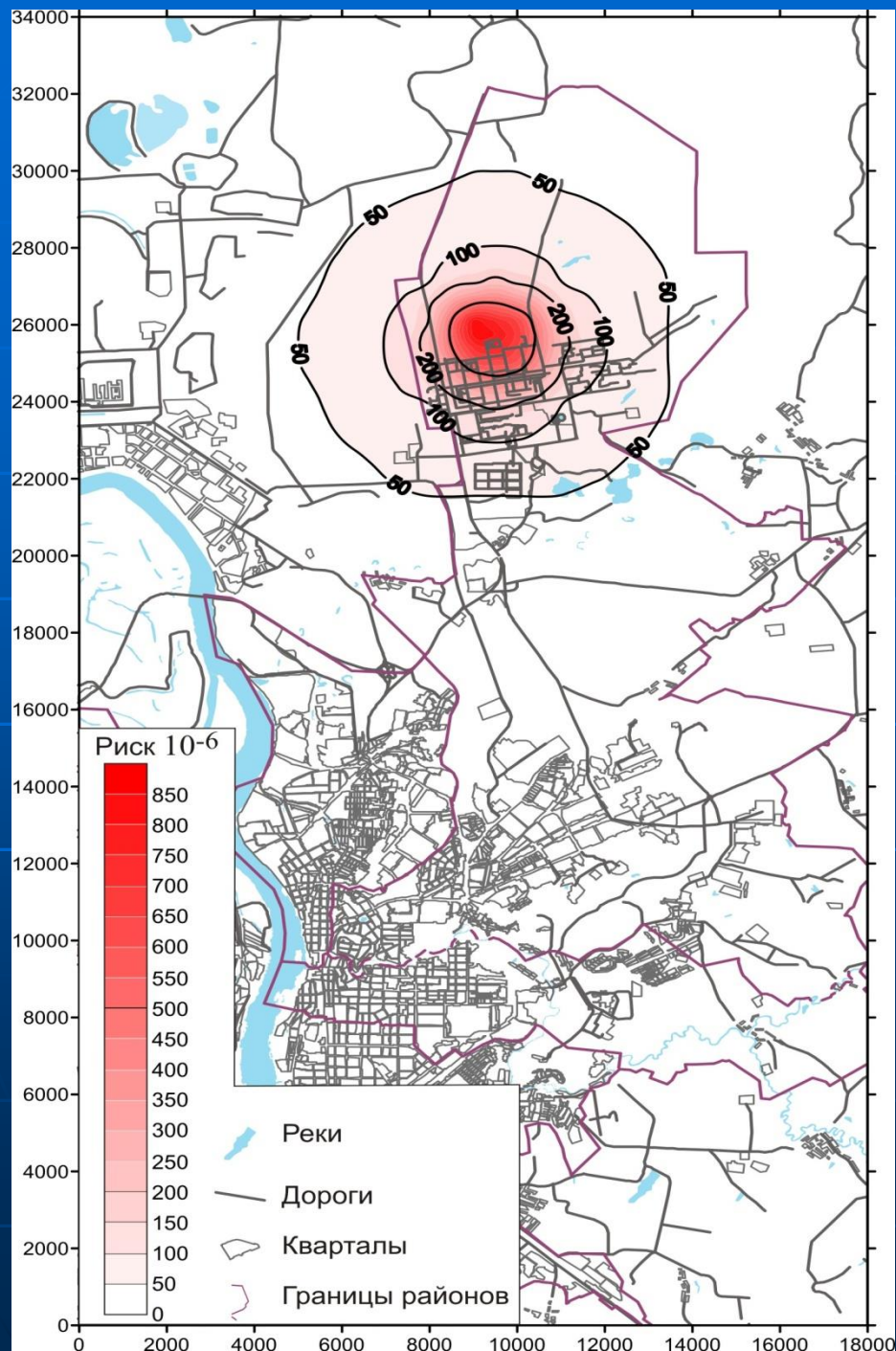
. The observation network for atmospheric air state: 2- Lenin Square, 5- Gerczen Street, 7- Tomsk Petrochemical Plant area, 11- Cheremoshniki area, 13- Lazo Street, 14 - Vershinin street

THE INDIVIDUAL CANCEROGENEOUS RISK, CAUSED BY FORMALDEHYDE, IN DIFFERENT CITY DISTRICTS FOR 1993 - 2002 years



THE CITY TERRITORY RANKING IN ACCORDANCE TO THE RISK LEVEL

OBSERVATION POST	THE INDIVIDUAL CANCEROGENEOUS RISK	THE ADDITIONAL EXPECTING DEATH QUANTITY (APPROXIMATELY) Per every 100000 people	THE RISK LEVEL
2	$1.5 \cdot 10^{-4}$	15	medium
5	$8,4 \cdot 10^{-5}$	8	low
11	$1,1 \cdot 10^{-4}$	11	medium
7	$2,3 \cdot 10^{-4}$	23	medium
13	$1,4 \cdot 10^{-4}$	14	medium
14	$9,3 \cdot 10^{-5}$	9	low



Human health risk levels at the territory of Tomsk caused by formaldehyde in the atmospheric air

CONCLUSION

- Formaldehyde is one of the harmful pollutants of atmospheric air . It occurs in sufficiently high concentrations in all areas of Tomsk.
- It causes disease of lung, upper airways. It is potential cancerogene.
- The main reasons of formaldehyde emissions into outdoor air pollution are fuel combustion and industrial processes at Tomsk Petrochemical Plant.
- Formaldehyde content in atmospheric air brings the additional contribution to the population disease.