Control Banding

Presentation in HKIOEH Conference 2007

TW TSIN

14th April 2007

Outline of presentation

- Background – a scenario
- Concept of control banding
- Putting into operation
- Applications
- Looking forward

A scenario in workplace – metal degreasing by solvent

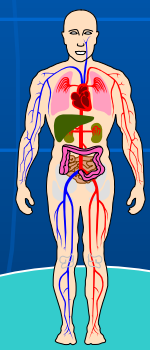
Making the risk assessment

- What is the material involved?
- How does the process work?
- Who are at risk?
- How frequent and exposed time?
- What is the exposure level? Exceeded OEL?
- What are the safe work practices?
- If the control for the tank satisfactory?
- If the ventilation adequate?
- If the PPE effective? ….

Exposure assessment

Hazard → Exposure measurement → Control

Air monitoring Vs Body Intake Model



Air contaminants

Other routes of entry

Probe Intake from air

Inhalation (intake)

Penetration

Absorption

Instrument

Body

The analogy

Collected amount

Dose amount

Personal Exposure

Body Uptake

Risk assessment

Control of chemical hazards

- Air monitoring by occupational hygiene principle - anticipation, identification, evaluation (including monitoring) and control
- Evaluation of environmental conditions
- Review in exposure & health effect and decision in acceptable exposure level
  - Code of Practice issued by Labour Department
- Recommendations of prevention and control measures

Issues SMEs facing

- Increased use of chemicals in varieties and widespread
- Insufficient knowledge and resources: Difficulty when without expertise
  - To assess the exposure of workers to chemical used
  - To set up the programme for proper preventive measures
  - To understand how to follow the law requirements

Control banding

- COSHH regulation since 1980s.
- Alternative risk assessment and management programme to satisfy the requirements
- COSHH essential of Health & Safety Executive, UK http://www.coshh-essentials.org.uk/
- SME benefited from experience sharing in hazard identification, prevention and control
- Similar situation in USA

The toolkit

- International chemical control toolkit (ICCT) promoted by ILO by control banding concept
- Based on COSHH essential, HSE
- IOHA initiation and collaboration
- Simplified version in easy steps of assessment & putting into practice
  - Banding the control measures in 5 + 1 simple strategies
- Initiative of international co-operation

Basic Concept of ICCT

- Shifting from exposure assessment to exposure control

Exposure Assessment

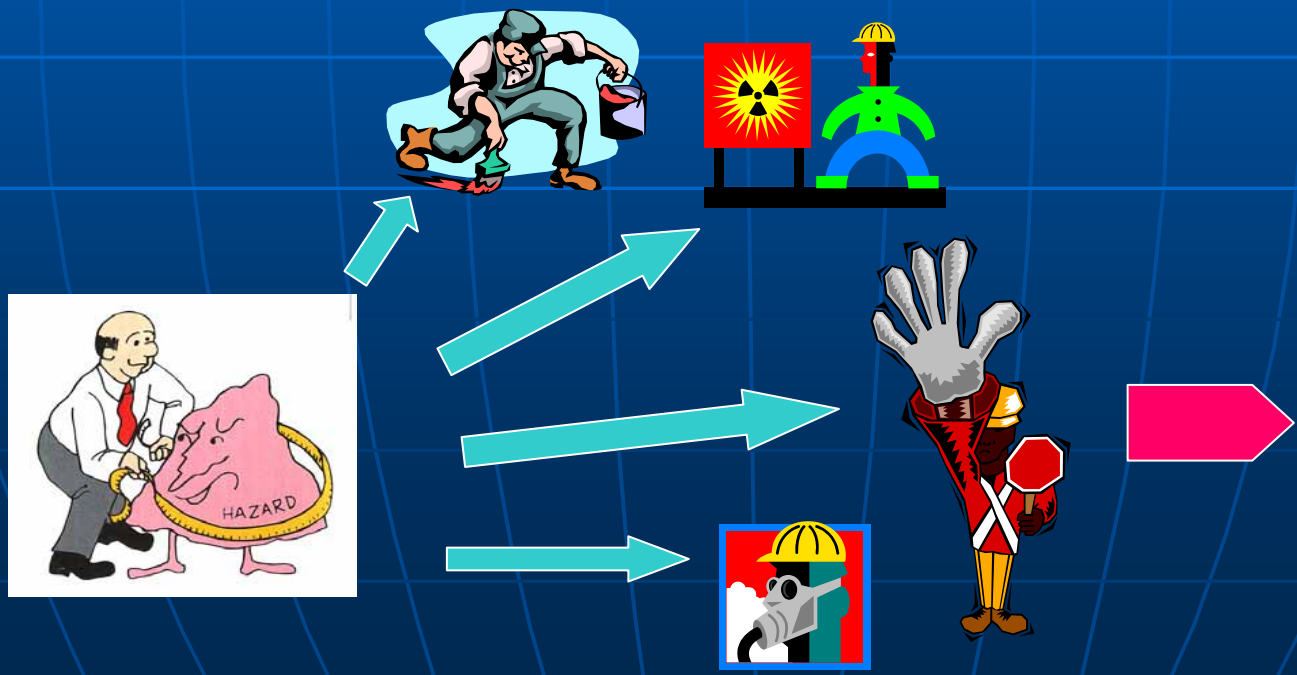
Hazard → Exposure measurement → Control

Hazard → Control → Exposure measurement

Exposure Control

The initiative

- The initiative of linking exposure scenario with prevention and control in the first instance
  - Banding of hazards, risk & control approaches



Why possible?

- Accumulated knowledge in toxicology and successful control of material concerned
- Basic information of material to users generally obtainable from suppliers, authorities and many other sources
- Control approaches are limited to only a few

The Hierarchy of control

- Elimination
- Substitution
- Modification
- Ventilation
- Containment
- Personal protection

- Therefore, simple to learn and to apply

Reasons for use

- Easy toolkit - Control orientated approach – readily available for field application
- Targeted to SMEs
- Reliable measures in simple step by step procedure
  - Most people with basic training in occupational hygiene/ chemical knowledge with hazard information can do
- Reallocation of resources to higher priority
- Complimentary to air monitoring for chemicals with OEL, and suitable for substances without OEL as well
- More comprehensive and practical than checklist approach

Benefits – Who & What?

- Employers – knows what to do for law compliance
- Employees – knows what and when need health protection when things go wrong
- Suppliers – good practice and information to clients; limited liability
- Trade associations – inform members and develop good practice
- Workers Unions – trained & informed union members and representatives
- Professionals – expert input to build up the database
- Law enforcer – common benchmark for compliance

ICCT in operation

- The five stages to solution
  - Hazard classification
  - Scale of use
  - Ability to become airborne
  - Finding the control approach
  - Finding the general or task-specific control guidance sheet(s)

Making use of risk phrases for assessment

- Innate properties of chemicals – grouping of chemicals with similar health effect into bands
  - Solution by similar effective prevention and control measures
- EU r-phrases (ICSC) or GHS
  - International recognised/ agreed database
  - e.g. Acetone :11-36-66-67 and Trichloroethylene: 45-36/38-52/53-67 from ICSC

ICSC GHS

Important elements of ICSC

TRICHLOROETHYLENE

CAS No: 79-01-6
RTECS No: KX4550000
UN No: 1710
EC No: 602-027-00-9

1,1,2-Trichloroethylene
Trichloroethene
Ethylene trichloride
Acetylene trichloride
C_2HCl_3 / ClCH=CCl_2
Molecular mass: 131.4

Occupational exposure limits
TLV: 50 ppm as TWA; 100 ppm as STEL; A5; BEI issued; (ACGIH 2004).
MAK: Carcinogen category: 1; Germ cell mutagen group: 3B; (DFG 2004).

PACKAGING & LABELLING

T Symbol
R: 45-36/38-52/53-67
S: 53-45-61
UN Hazard Class: 6.1
UN Pack Group: III

Do not transport with food and feedstuffs. Marine pollutant.

SAFE STORAGE

Separated from metals (see Chemical Dangers), strong bases, food and feedstuffs. Dry. Keep in the dark. Ventilation along the floor.

Hazard bands based on risk phases

Hazard Group		EU R-Phrases	GHS hazard classification (class/level)
A	D	R48/23/24/25, R26/27/28, R39/26/27/28, R40 Carc. Cat. 3, R60, R61, R62, R63, R64	Acute toxicity (lethality), any route, class 1 or 2 Carcinogenicity class 2 Repeated exposure toxicity, any route, class 1 Reproductive toxicity class 1 or 2
B	E	R42, R45, R46, R49,R68	Mutagenicity class 1 or 2 Carcinogenicity class 1 Respiratory sensitisation
C	S skin and eye contact	R21, R24, R27, R34, R35, R36, R38, R39/24, R39/27, R40/21, R41, R43, R48/21, R48/24, R66	Acute toxicity (lethality), dermal only, class 1, 2, 3 or 4 Acute toxicity (systemic), dermal only, class 1 or 2 Corrosivity, subclass 1A, 1B or 1C Skin irritation class 2 Eye irritation class 1 or 2 Skin sensitisation Repeated exposure toxicity, dermal only, class 1 or 2

Table 2: Hazard group allocation from classification definitions

Banding the hazards

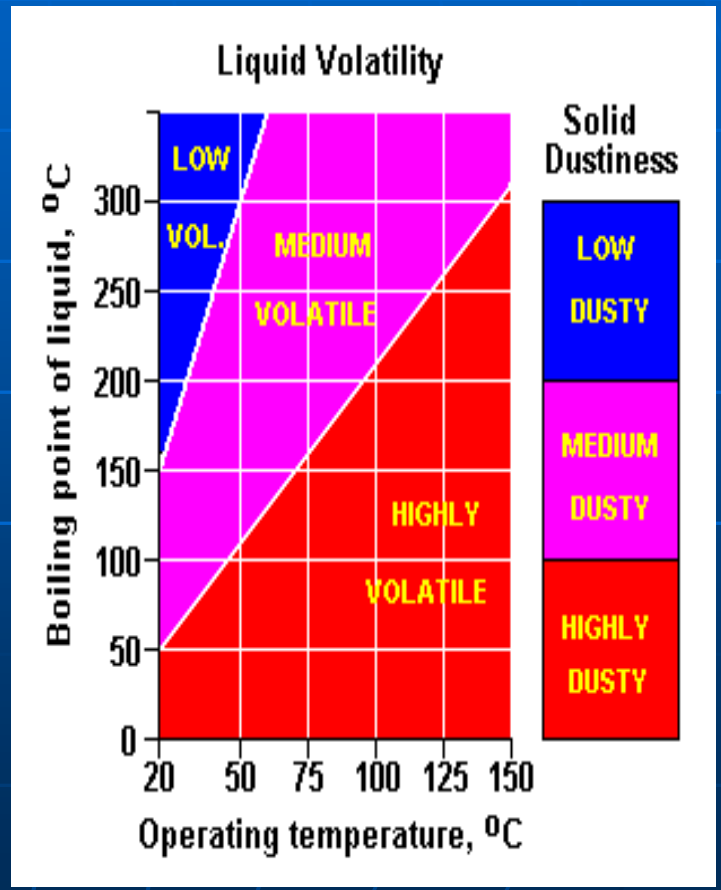
- Classifying chemicals according to the r-phrases (numbers) and fit into the group

Substance	Hazard group	Volatility
Acetone	A & S	Medium
Butyl acetate	A & S	Medium
Diesel	B & S	Low
Ethyl acetate	A & S	Medium
Hexane	B & S	Medium
Isopropyl alcohol	A & S	Medium
Methanol	C & S	Medium
Methyl ethyl ketone	A & S	Medium
Methyl isobutyl ketone	B & S	Medium
Paraffin (Kerosene)	A & S	Low
Perchloroethylene	C & S	Medium
Petrol	B & S	High
Toluene	B & S	Medium
Trichloroethylene	C & S	Medium
White spirit (Mineral spirit)	B & S	Low
Xylene	A & S	Medium

Table 1: Hazard group identification for common solvents.

Airborne ability (simulating exposure)

- Amount of use and emission rate is proportional to air pollution in workplaces
- Amount (scale) in use – in a batch or a period
- Classification by ml, litre, cubic meter & gram, kilo, tonne
- Volatility of solvent vapour (intrinsic emission), way of handling (dust exposure by operations)



Risk banding

- Degree of risk – pending on results for the exposure & hazard band of the situation under study

Amount used	Low dustiness or volatility	Medium volatility	Medium dustiness	High dustiness or volatility
Hazard group A				
Small	1	1	1	1
Medium	1	1	1	2
Large	1	1	2	2
Hazard group B				
Small	1	1	1	1
Medium	1	2	2	2
Large	1	2	3	3
Hazard group C				
Small	1	2	1	2
Medium	2	3	3	3
Large	2	4	4	4
Hazard group D				
Small	2	3	2	3
Medium	3	4	4	4
Large	3	4	4	4
Hazard group E				
For all hazard group E, substances, choose control approach 4				

Table 4: Control approach selection

Control approaches

- Consideration in 3-dimensions : hazard bands, quantity in use & airborne ability (exposure) for determining effective means of control
- Control options based on specific operations
- Next consideration - skin and respiratory protection

Amount used	Low dustiness or volatility	Medium volatility	Medium dustiness	High dustiness or volatility
Hazard group A				
Small	1	1	1	1
Medium	1	1	1	2
Large	1	1	2	2
Hazard group B				
Small	1	1	1	1
Medium	1	2	2	2
Large	1	2	3	3
Hazard group C				
Small	1	2	1	2
Medium	2	3	3	3
Large	2	4	4	4
Hazard group D				
Small	2	3	2	3
Medium	3	4	4	4
Large	3	4	4	4
Hazard group E				
For all hazard group E, substances, choose control approach 4				

Table 4: Control approach selection

Control sheets

Task description	Task control sheet
Control Approach 1	
General principles	100
Sack, bottle and drum storage	101
Bulk storage	IBC filling and emptying 208
Removing wast	Drum filling 209
	Drum emptying with
General princip	Weighing solids
Ventilated work	Mixing liquids with lic
Ventilated boot	Mixing solids
Removing wast	Sieving
C	Screening
S	Drum filling
Sack emptying	IBC filling and emptying (liquids)
Charging react	Vapour degreasing b
	Tray drying oven
	Pelletising
	Tablet press

Control Approach 3	
General principles	300
Glove box	301
Removing waste from extraction unit	302
Transferring solids	303
High throughput sack emptying	304
	305
	306
	307
	308
Tanker filling and emptying (solids)	309
Tanker filling and emptying (liquids)	310
Keg filling	311
Transferring liquid by pump	312
Filling small containers (packets and bottles)	313
Weighing solids using a load cell	314
Weighing liquids using a load cell	315

Control Approach 4	
General principles	400

Worked examples

- Degreasing of metal ware

Potential problems

- Scenarios – metal degreasing in vapour degreaser
- Inhalation, skin contact hazard
- Contributing factors to higher exposure
  - Diffusion, evaporation, drag out effect, displacement effect, condensation & vessel effect, spill/ leakage

Procedure for Risk assessment

- Use of trichloroethylene - Check Tasks and Operations
  - Decide the Hazard band
  - Scale of use in a day/ batch
  - Degree of airborne ability (e.g. volatility)
  - Determine the risk band and control approaches
  - Check from tasks control sheets.

Results of analysis by ICCT

- TCE in degreasing (bp =87 C)
- C + S
- 60 litres/ day
- Medium use
- High volatility
- 60 times a day for 2 minutes
- CA3 - Containment: see 300 and 318
- PPE requirement

318

- TCE in degreasing (bp =87 C)
- C + S
- 0.5 litre/ day
- Small use
- High volatility
- 6 times per day for 2 to 5 minutes
- CA2 – local exhaust: see 200 and 218
- PPE requirement

218

Recommended applications in Hong Kong situation

- SME daily operations
  - Simple and small scale operations
- Plants of large enterprises having normal production with commonly used chemicals
  - Known quantity of simple chemicals in routine operations and for validation
  - Focus on large scale industries and develop new measures for experience sharing
- Compliance to the local regulations!?!
  - Alternative to compliance in CoP of OEL
  - The F&IU (Safety management) Regulation

Health hazard evaluation & control F&IU (SM) Regulation

- 14 Elements in Safety Management System
- Item 6 of Part 1
  - A programme to identify hazardous exposure or the risk of such exposure to the workers and to provide suitable personal protective equipment as a last resort where engineering control methods are not feasible.

Elements in Part 3 - not yet in operation

- Item 1 of Part 3
  - Evaluation of job related hazards or potential hazards and development of safe work procedures.
- Item 3 of Part 3
  - A programme for accident control and elimination of hazards before exposing workers to any adverse work environment.
- Item 4 of Part 3
  - A programme to protect workers from occupational health hazards.

Present Position

- ICCT – the draft version developed under the concept of Control Banding is available on-line for practice
  - http://www.ilo.org/public/english/protection/safework
- Translation of concepts and common phrases of the toolkit to meet “local requirements”

Precautions in application

- Scale of use in daily (continuous) operation/ batch
  - Grams, kilo and ton for particulate
  - ml, litres and cubic meters for vapour
  - *May not be sensitive to duration and frequency*
- Airborne ability and condition
  - Liquid or solid
  - *May not account for working temperature or energy at generating points, dispersion pattern, personal factors, etc.*
- Complicated process or mixed exposure
  - *Care in matching of risk phrases with the hazard bands*
  - *Care in selecting and implementing the measures*
- Non-standard processes require new (full) risk assessment
  - *Work condition, job activity and environmental factors*
  - *Air monitoring is required for validation*

Looking forward

Planning for implementing Control Banding/ ICCT

- Capacity Building (Training)
- Development and testing of guidance
- Translation into other languages
- Application of more generic approach
- Full implementation

Some technical issues

- Field test of the existing version
  - Effectiveness of predicting exposures
  - Validation of controlling exposures
- Investigation of applications to skin exposure, and its effect when integrated with inhalation route of exposure
- Translation of the guidance into different languages: coordinated under WHO OH CC
- Final agreement in risk phrases – GHS

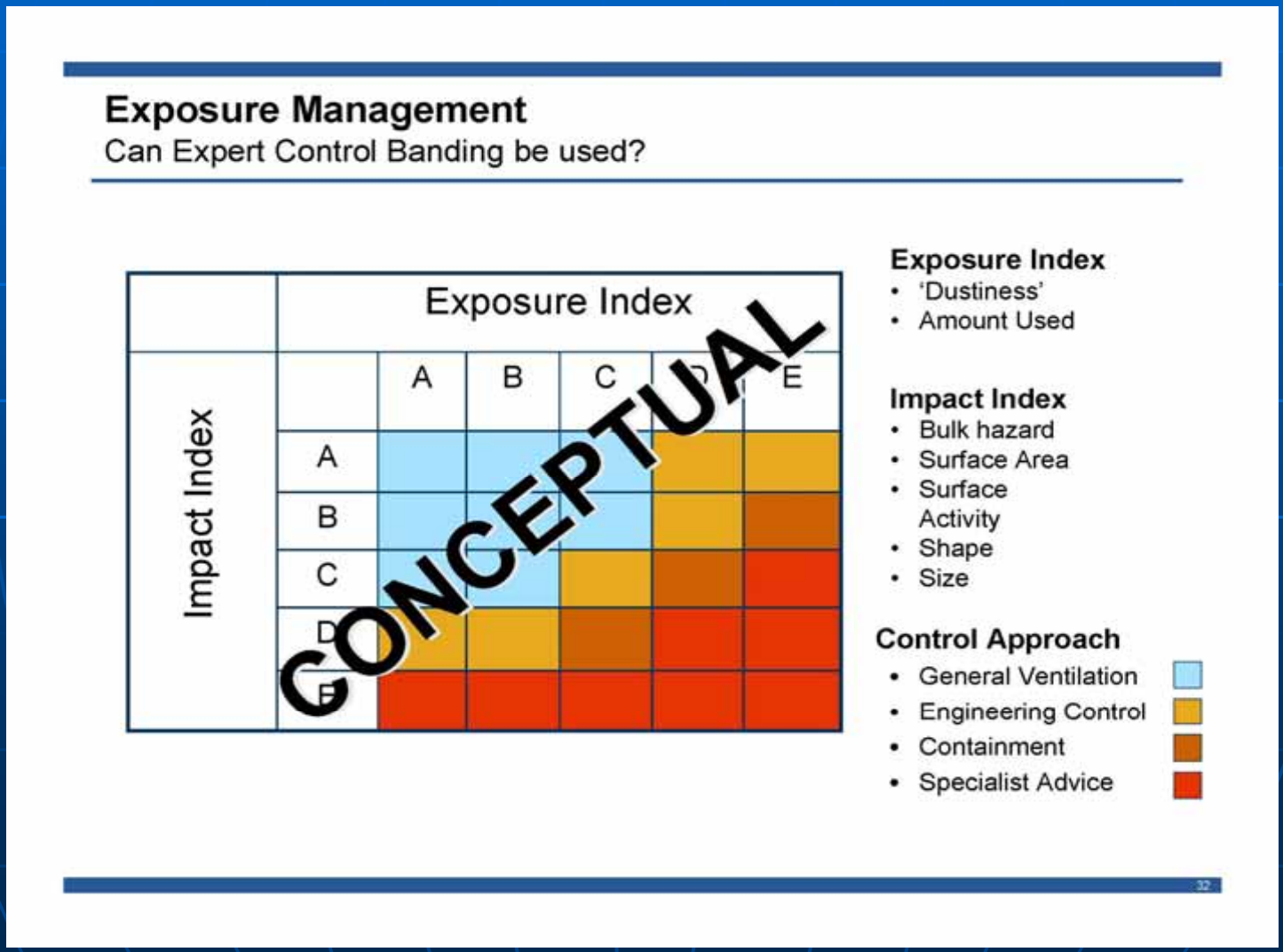
- Occupational hygiene input on expanding the knowledge in ranking hazards, prioritsing controls, etc.
  - Modifications or additional model to suit local conditions/ practices
- Review and continuous improvement by Control Banding International Technical Group (ITG) coordinated by ILO/ WHO (under the IPCS cooperation)

New directions

Expansion of the concept in other areas of occupational safety and health

- Silica dust hazard,
- Asbestos hazard
- Ergonomics
- Noise control
- Safety
- Nanotechnology, etc.

Nanotechnology and control banding (after A Maynard 2005)



Thank you

Comment & suggestion for improvement; feedback from participants to ITG/ IPCS: via hkioeh@netvigator.com