Wuhan University of Technology

《Blasting Engineering》 Classic course

Chapter 2 Industrial Explosive

主要内容：

2.1 Basic Concept

2.2 Single primary explosive and High explosive

2.3 Ammonium nitrate explosive

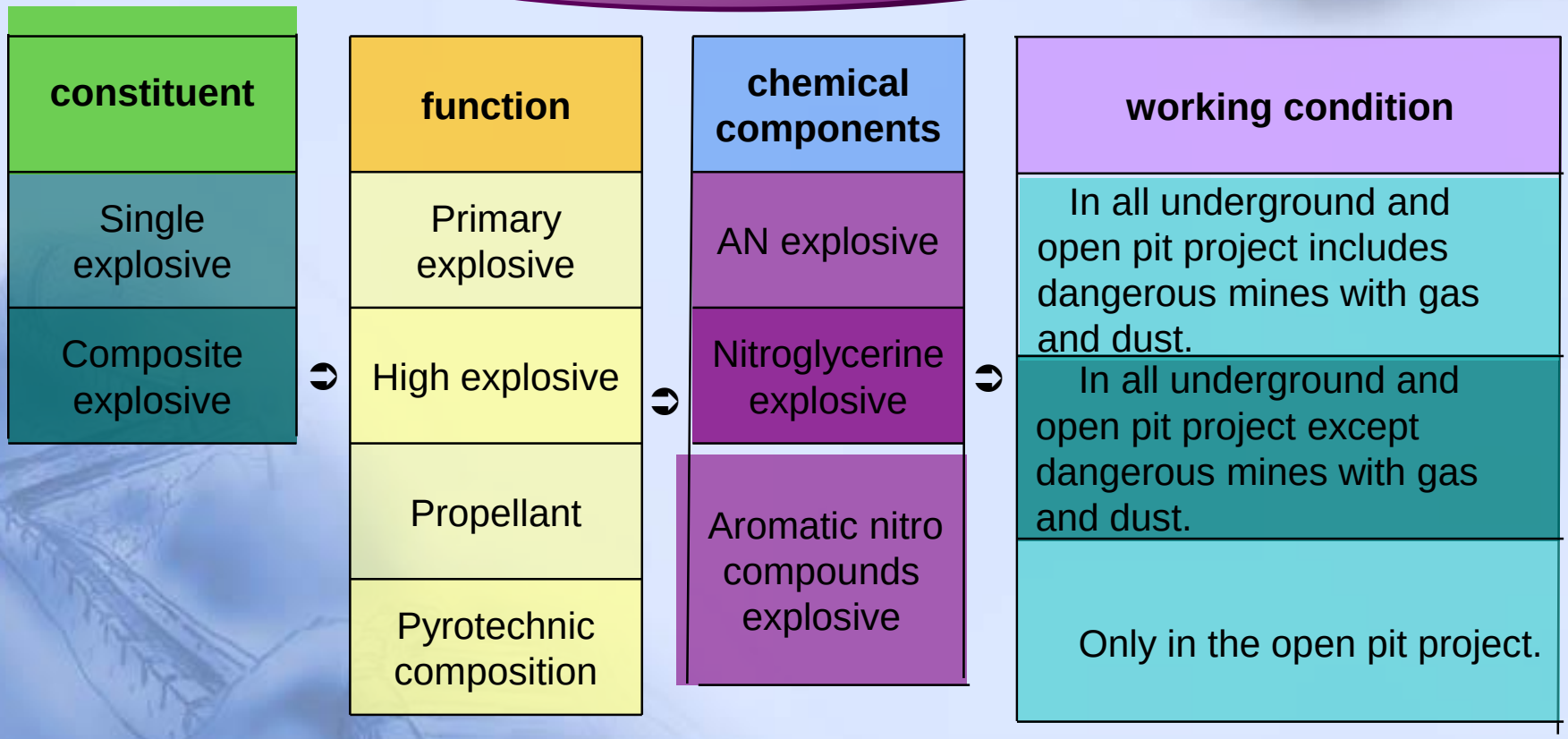
2.4 Permitted explosive for coal mine（omited）

2.5 Other industrial explosives（omited）

2.6 Brief introduction to the method of destruction of blasting equipment（omited）

Section 1 Basic Concept

Classification of explosive



The basic requirements of industrial explosive in Industrial blasting

Low mechanical sensitivity and modest initiation sensitivity，convenient and safe in production,storage,transportation and working.

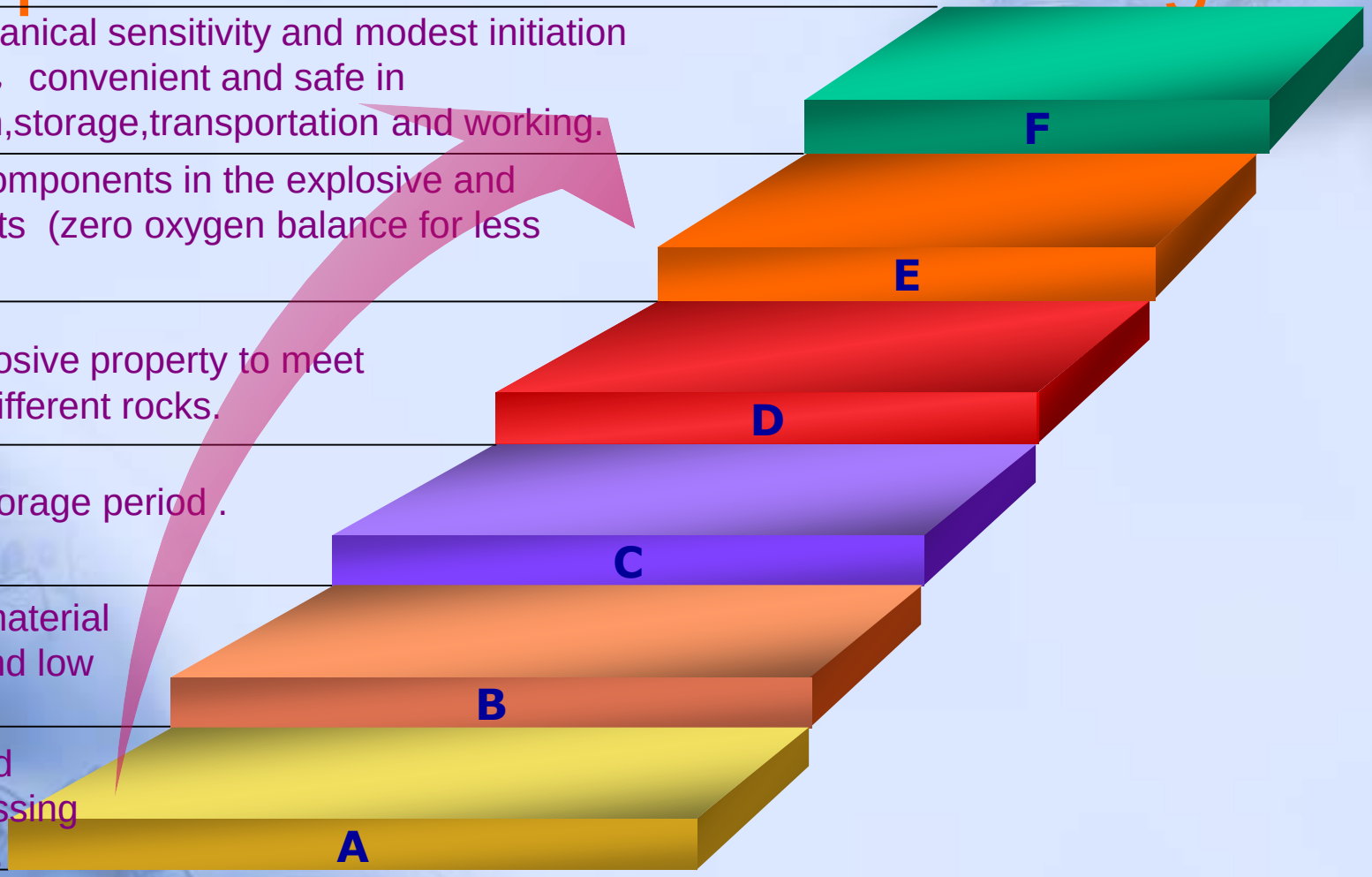
No toxic components in the explosive and components (zero oxygen balance for less toxic gas).

Good explosive property to meet needs of different rocks.

Stable in storage period .

Wild raw material sources and low price.

Simple and safe processing technology.



Section 2 Single primary explosive and high explosive

Single primary explosive

A

Fulminate

Molecular Formula $Hg(ONC)_2$

Structural formula $Hg\langle^{O-N\equiv C}_{O-N\equiv C}$ or $Hg\langle^{O-N=C}_{O-N=C}$

B

Lead azide

Molecular Formula $Pb(N_3)_2$

Structural formula $Pb\langle^{N=N\equiv N}_{N=N\equiv N}$

Low thermal sensitivity and strong explosion power.

C

Dinitrodiazophenol —— **DDNP**

Molecular Formula $C_6H_2N_4O_5$

Pure DDNP is yellow needle crystal,flame sensitivity is higher than that of dextrin lead azide and similar with mercury fulminate.Explosion power is two times than that of mercury.DNNP is currently the most widly used.

Single high explosive『1』

A TNT

Melting point 80.65℃。

Insoluble in water, soluble in toluene, high thermal stability

TNT can be flamed and when it is flamed in a closed condition or in a big amount,it can be transformed into explosion.

Low mechnical sensitivity but easy to explosion if mixed with hard granule.

TNT is toxic ! It can cause toxic hepatitis and aplastic anemia，and results in jaundice, blue disease, gastrointestinal dysfunction and red, leucopenia disease.In addition,it can cause cataract, and affect reproductive function

Single high explosive『2』

B Hexogeon

RDX $C_3H_6(NO_2)_3$

Mechanical sensitivity is higher than TNT

Explosive strength 500mL，brisance（25g）16mm，explosion velocity 8300m/s。It can be used not only as strengthen explosive in the detonators but also as cored of detonating fuse or mixed with TNT to produce initiation charge.

C Tetryl

CE $C_6H_2(NO_2)_3 \cdot NCH_3NO_2$

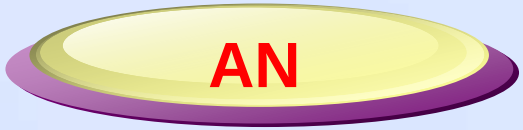
Tetryl is pale yellow crystals.

D PETN

pentaerythrite tetranitrate $C(CH_2ONO_2)_4$

PETN is white crystal，its explossion properties is same with RDX.

Section 3 Ammonium nitrate explosive



（ammonium nitrate）Structural formula： NH_4NO_3 oxygen balance： ＋19.98% explosion velocity ： 100~2700m/s critical diameter：100mm

AN cannot be detonated by detonator or detonating cord ， its major defect is high hygroscopicity and caking capacity.To increase its water-resisting property,we can add anti-blushing agent in it.

1：Hydrophobic substances （rosin, paraffin wax, bitumen and vaseline）；
2：active substance（Calcium stearate, zinc stearate ）。

Relationship between high hygroscopicity and caking capacity ：

Tautomeric properties of ammonium nitrate crystal：

- Usually，AN has five crystalline:A square,α diamond, βdiamond, oblique parallelepiped and hexahedron.
- When the temperature rises to 32.3 ℃，The volume of αdiamond crystal will increase 3%, and split into β diamond crystals。

AN can react with copper to produce nitrite with poor stability.

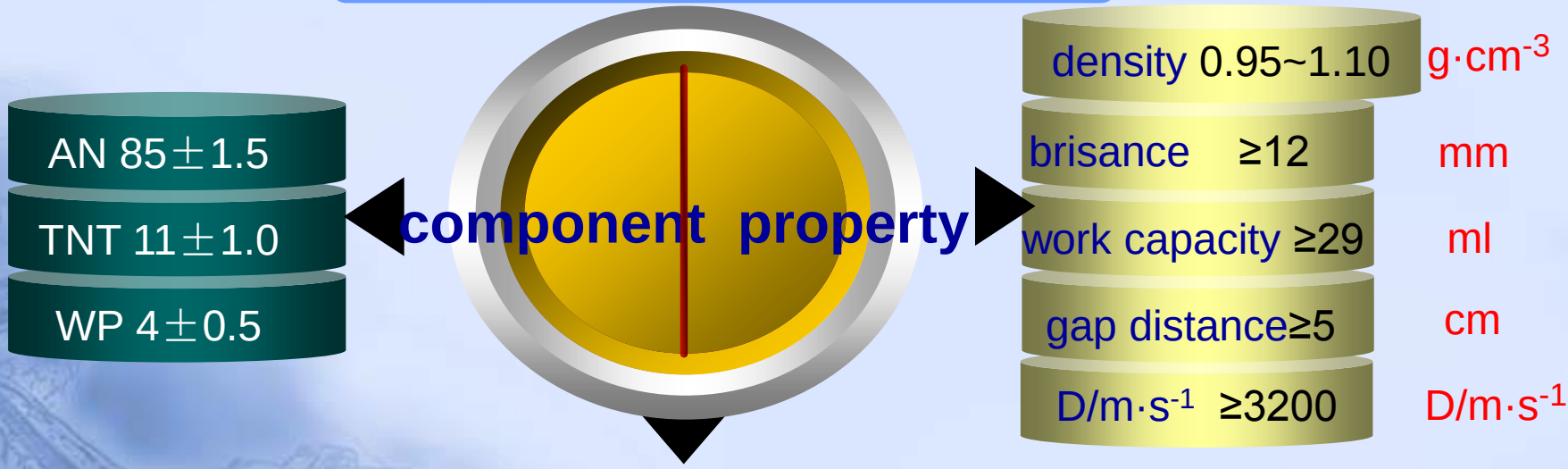
Process of AN Hygroscopicity, caking

Amnonite

amnonite

Consists of Ammonium nitrate, TNT and wood powder.

1. AN is the main component and oxidizing agent.;
2. TNT is sensitizing agent and reducing agent.
3. Wood powed is leavening agent.



No. 2 rock AN TNT explosive

ANFO Explosive

ANFO

（ammonium nitrate fuel oil mixture / ANFO explosive）

ANFO explosive consists of ammonium nitrate and fuel oil,it is granular or powdery explosive mixture.Referred to as the blasting agent.

The raw materials of ANFO explosive are Ammonium nitrate, diesel oil and wood powder.

The reasonable components ration of powdery ANFO explosive is ammonium nitrate: diesel oil: wood powder =92:4:4

ANFO explosive has low sensitivity and relatively high hygroscopicity and caking capacity so it cannot be used in water environment.

Classification of ANFO explosive

A ANFO explosive （ANFO explosive） → As above

B heavy ANFO

Mixed W/O type emulsion matrix with granular ANFO in a certain ratio to produce mixture which is usually called heavy ANFO or latex granular ANFO。

C Expanded ammonium nitrate fuel oil explosive

ANFO which is made by porous granular ammonium nitrate or expanded ammonium nitrate is called Expanded ammonium nitrate fuel oil explosive

D AN-rosin-wax explosive and AN-asphalt-wax explosive

- AN-rosin-wax explosive → raw materials:ammonium nitrate, rosin and paraffin wax
- AN-asphalt-wax explosive → raw materials:ammonium nitrate, asphalt and paraffin

Slurry explosives and water gel explosive

Slurry Explosive

Water resistant AN explosive.

basic components:Oxidant solution, sensitizing agent and coagulant

difference:

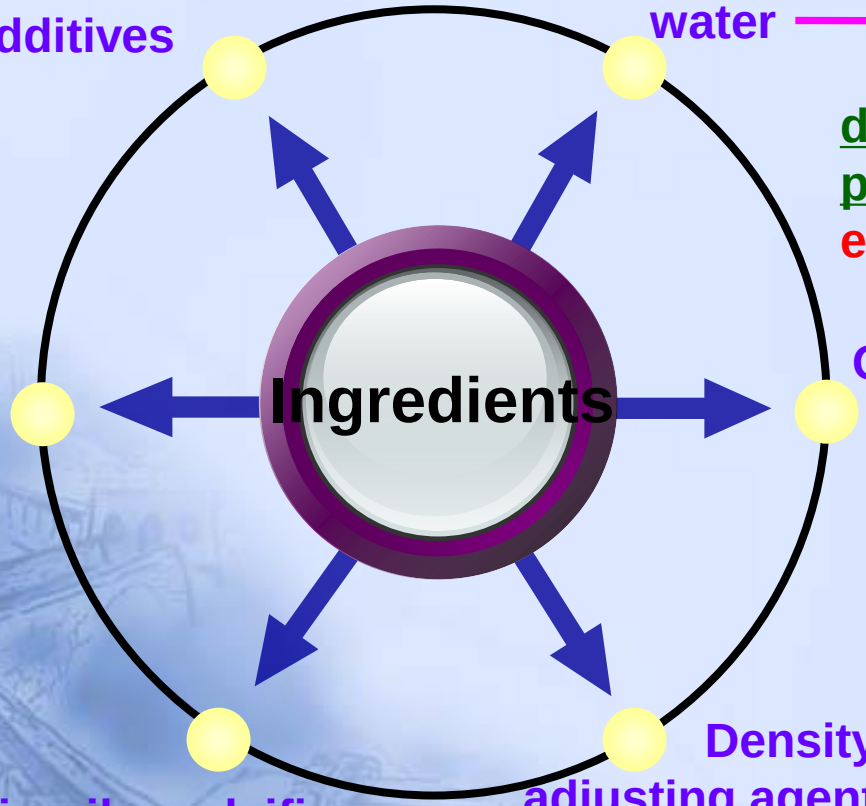
The main sensitizing agent is insoluble ingredients of explosives, metal powder and solid combustible

Water Gel Explosive

There is no strict difference between water gel explosive and slurry explosive.**The main difference is sensitizing agents.**

The main sensitizing agent is soluble methylamine nitrate.

Main ingredients of emulsion explosives



Water and oxidant which form discrete phase or aqueous phase,internal phase of emulsion explosives

Oil Phase Material

1st class water-insoluble organic matter which forms continuous phase or external phase.

Density adjusting agent { Tiny bubbles; Closed solid particles with gas


Thank You !
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