Explosion during primary explosive process

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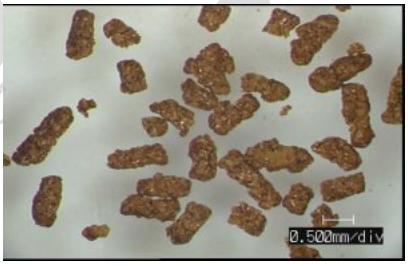
Background

- **DDNP powder is produced as a primary explosive of electric detonator.**
- **DDNP powder is granulated in continuous production process.**



Granulated DDNP powder

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Background

- The process consists of mixers, a granulator, dry conveyors, a measurement device, and a takeout robot.
- Operators are able to check the status of machines by remote controlled TV monitors and small windows that are located at the concrete wall.

Operating room

Remote TV monitor

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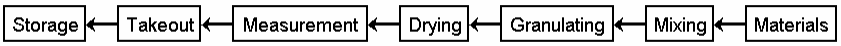
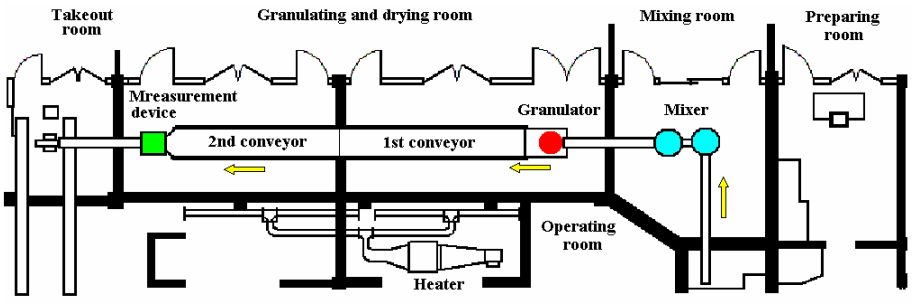
Outline of the process





Layout view of the accident place

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Composition of DDNP powder

Storage ← Takeout ← Measurement ← Drying ← Granulating ← Mixing ← Materials

Table Composition of DDNP Powder

Materials		Wet	Dry
		Composition (wt%)	
DDNP (Diazodinitrophenol)		42.69	49.84
$KClO_3$ (Potassium chlorate)		42.69	49.84
Water-soluble cellulose ether (Binder)		0.09	0.10
Powder for preventing static electricity		0.02	0.02
Ethanol / water (wt%: 50/50)		14.51	
Water			0.20
Total		100	100
Sensitivity	Drop-Hammer test	Grade 1	Grade 1
	Friction sensitivity	Grade 1	Grade 1

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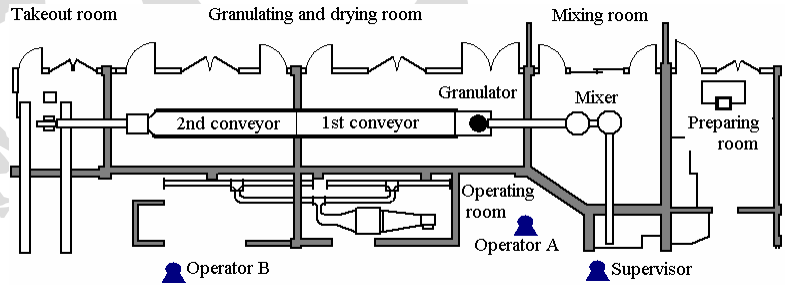
Accident

- **At 8:58 on Wednesday, 12th June, 2002, an explosion occurred in the continuous production process of DDNP powder.**
- **Approximately 2.6 Kg of DDNP powder fired and detonated.**
- **No persons were injured.**



Layout view of the accident place

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Damage

Granulator

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Damage

☐st dry conveyor

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Damage

□nd dry conveyor
and ceiling

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Damage

Outside view of
the accident place

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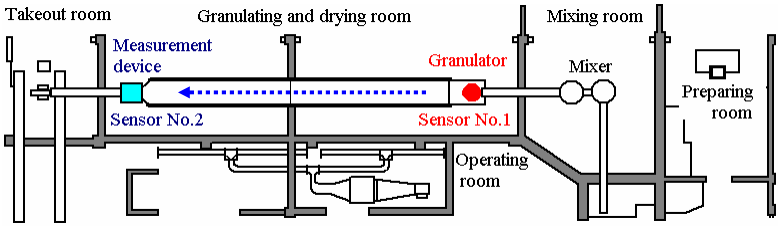
Analysis

- Where did it ignited ?
- How did it ignited ?
- Why did it happen ?

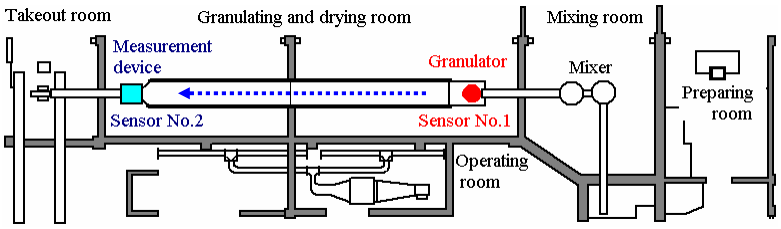
Where did it ignite ?

- The ignition occurred around granulator.
  - Remained the detected signals in the control unit
  - Initiation sensitivity property of DDNP powder



How did it ignite ?

- The fire propagated to DDNP powders on the conveyor.
- The status of combustion was changed to deflagration and finally detonation occurred.



Why did it happen ? (1)

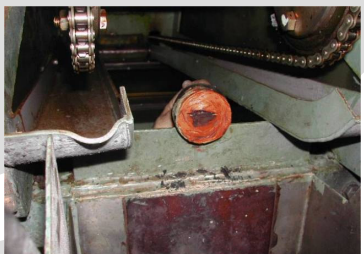
- The crack of plate made by PVC
- The residue of DDNP powder inside the crack.
- Grown the crack of PVC plate in the bended part
- Separated the plate
- Ignition of the residue of DDNP powder by the impact and friction

Why did it happen ? (2)

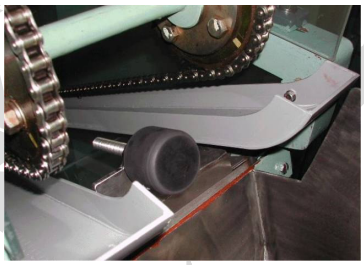
- Generated rust in the stopper of the equipment to supply DDNP powder
- Mixing the DDNP powder and rust in the granulator
- Increased ignition sensitivity of the mixtures
- Ignition of the DDNP powder by the impact and friction in the granulator

Action to prevent recurrence

- Improvement of the part made by PVC
- The parts that can be the cause of rust were improved.
- Reeducation to operators concerning the accident
- Dangerous potential of primary explosive residue inside the parts
- Importance of thorough cleaning of equipments
- Improved the inspection system for equipments



Before



After

Improvement of stopper and dry conveyor

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Before

After

Improvement of dry conveyor

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