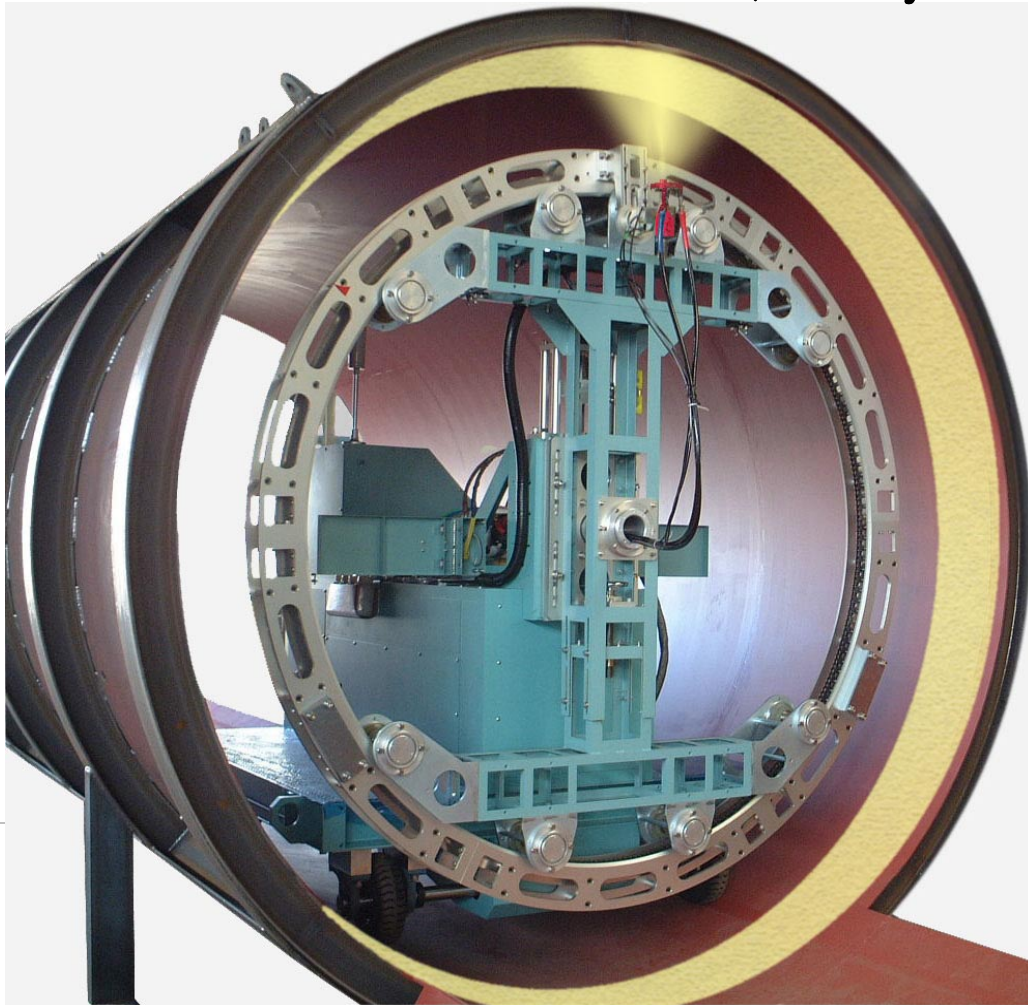


# Automatic Internal Lining System

( Polyurea NNT Method )



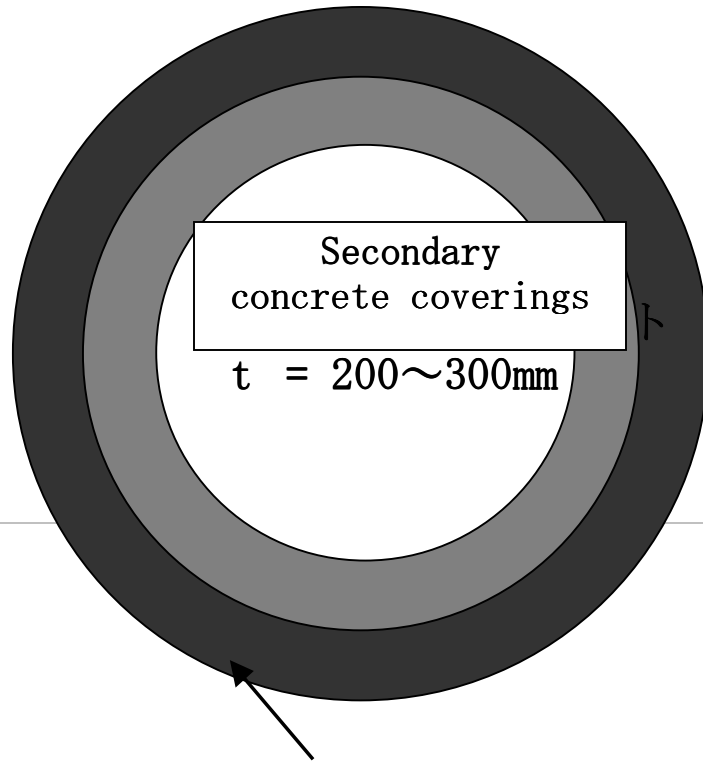
10 December 2002

IZUMO & KAKIBA

NIPPON PAINT CO. LTD.

# Functions of Secondary concrete coverings

at Sewage shield tunnel



Primary concrete coverings

Expected Functions	Pros & Cons	Trend of Importance
Meandering adjustment	○	↓ down
Internal smoothing	○	↓ down
Watertight	○	↓ down
Anti-Corrosion	×	↑ up
Reinforcement	△	↓ down

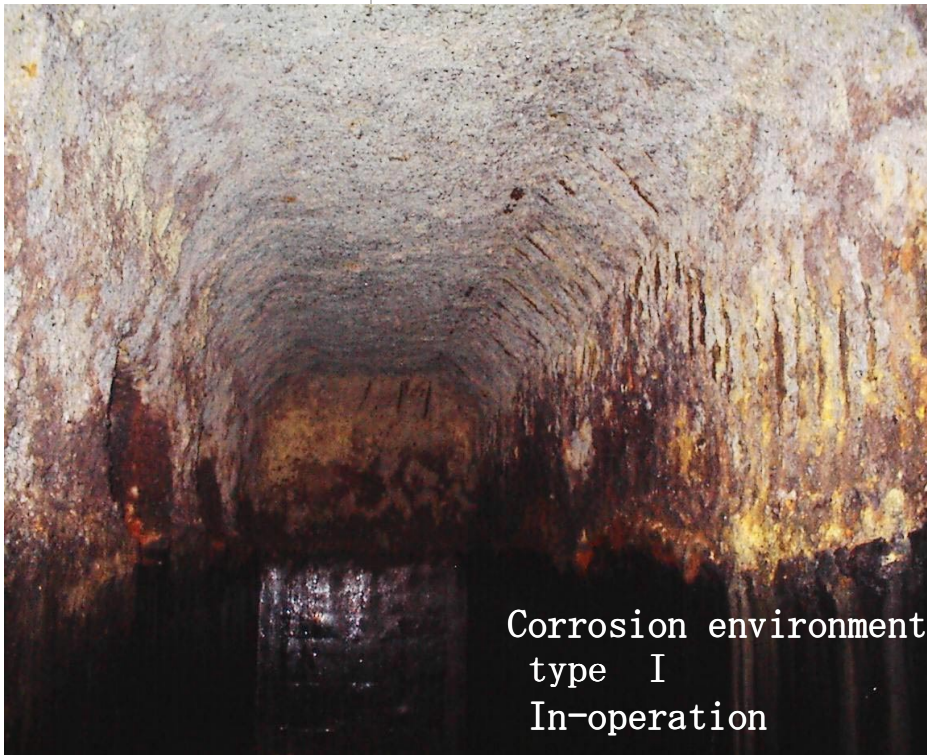
Secondary concrete covering becomes less important  
with developments in accurate excavation technology



Increasing needs for  
Anti-Corrosion & Reinforcement  
i. e. new method

## Types of Corrosion Environment used by Japan Sewage Works Agency

Types	Corrosion Environment
I	Extreme harsh condition by sulfuric acid at Av. more than 50 ppm of H <sub>2</sub> S gas
II	Very harsh condition by sulfuric acid at Av. 10--50 ppm of H <sub>2</sub> S gas
III	Harsh condition by sulfuric acid at Av. Less than 50 ppm of H <sub>2</sub> S gas
IV	Acid condition but not sulfuric acid



# The standard of Anti-corrosive materials approved by JSWA

Corrosion types	I & II	II & III	III	IV
Types of materials	D	C	B	A



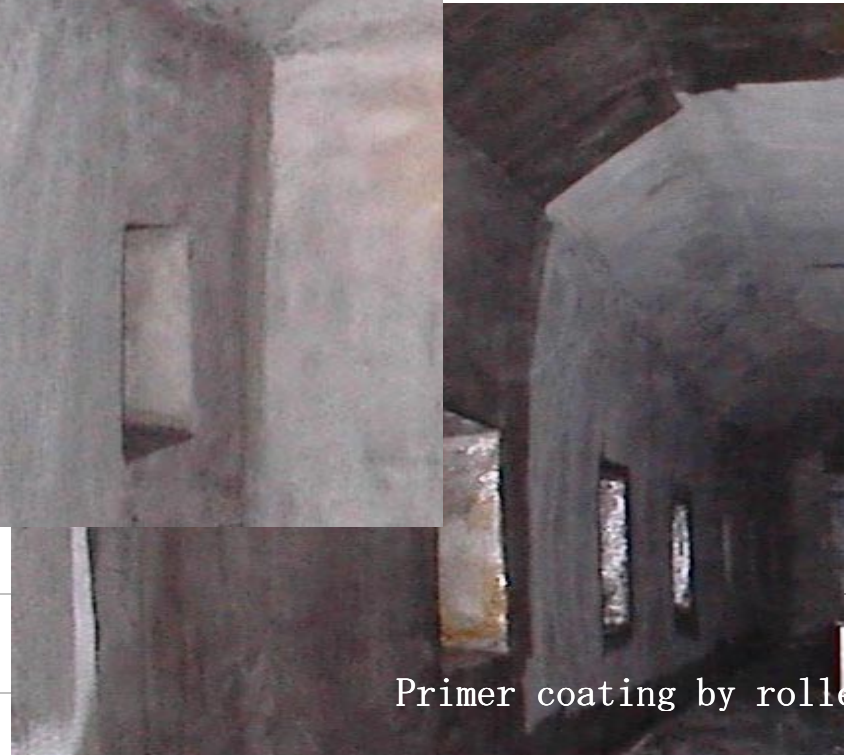
Polyurea : 3mm DFT



Restore concrete

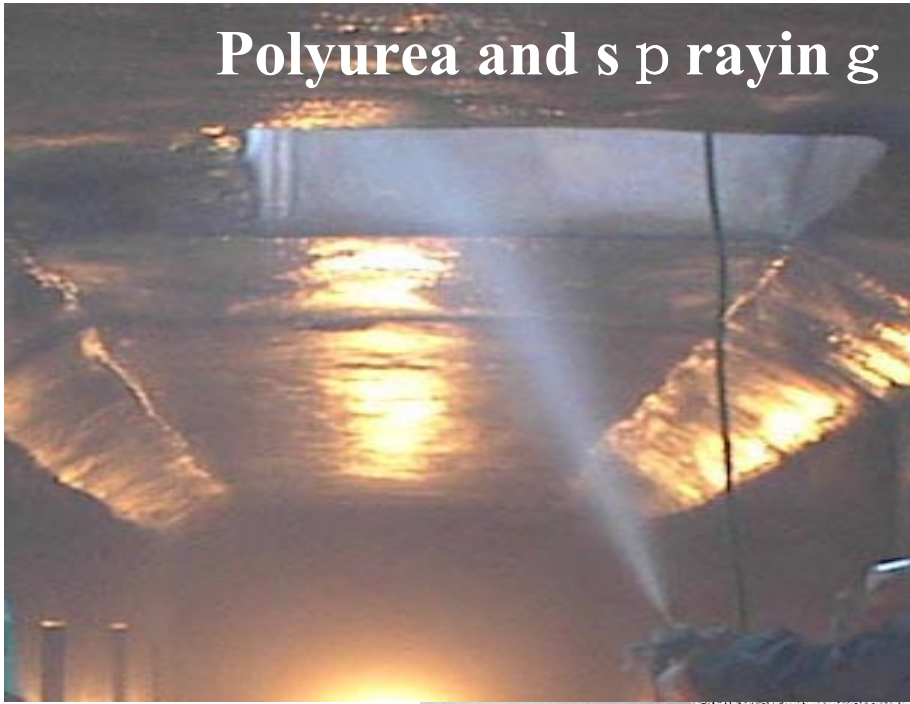


Restore reinforced bar

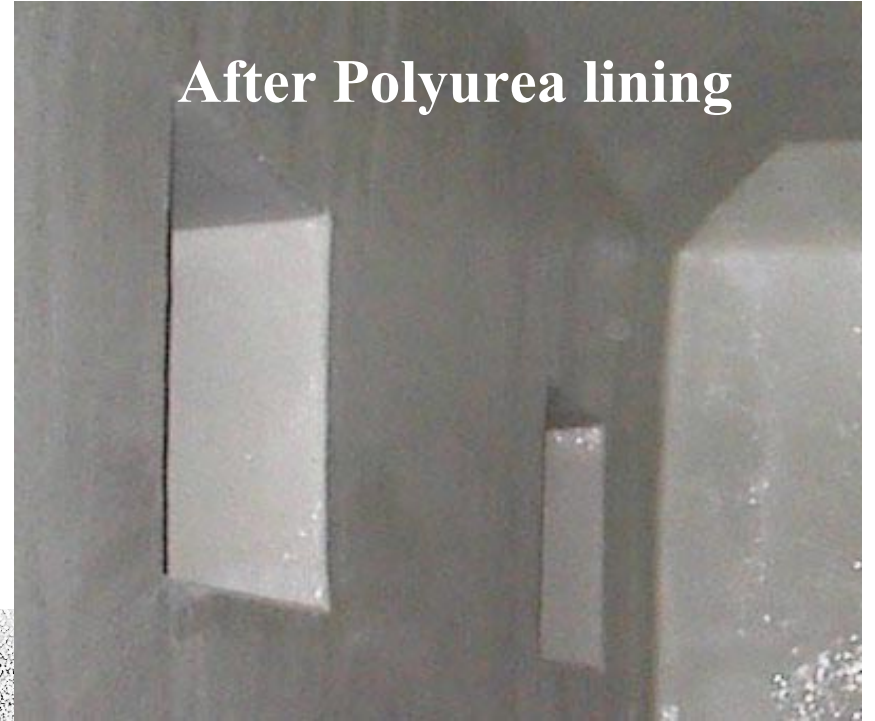


Primer coating by roller

Polyurea and sprayin g

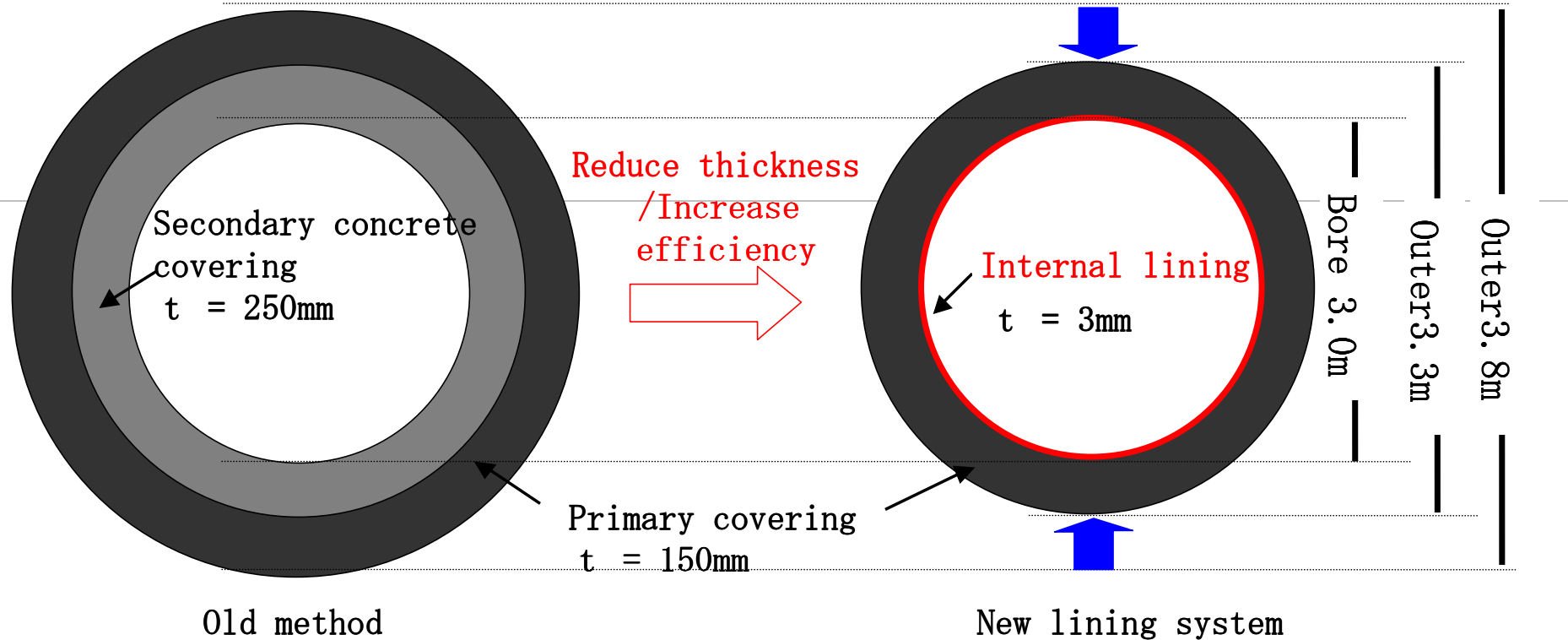


After Polyurea lining



restart operation

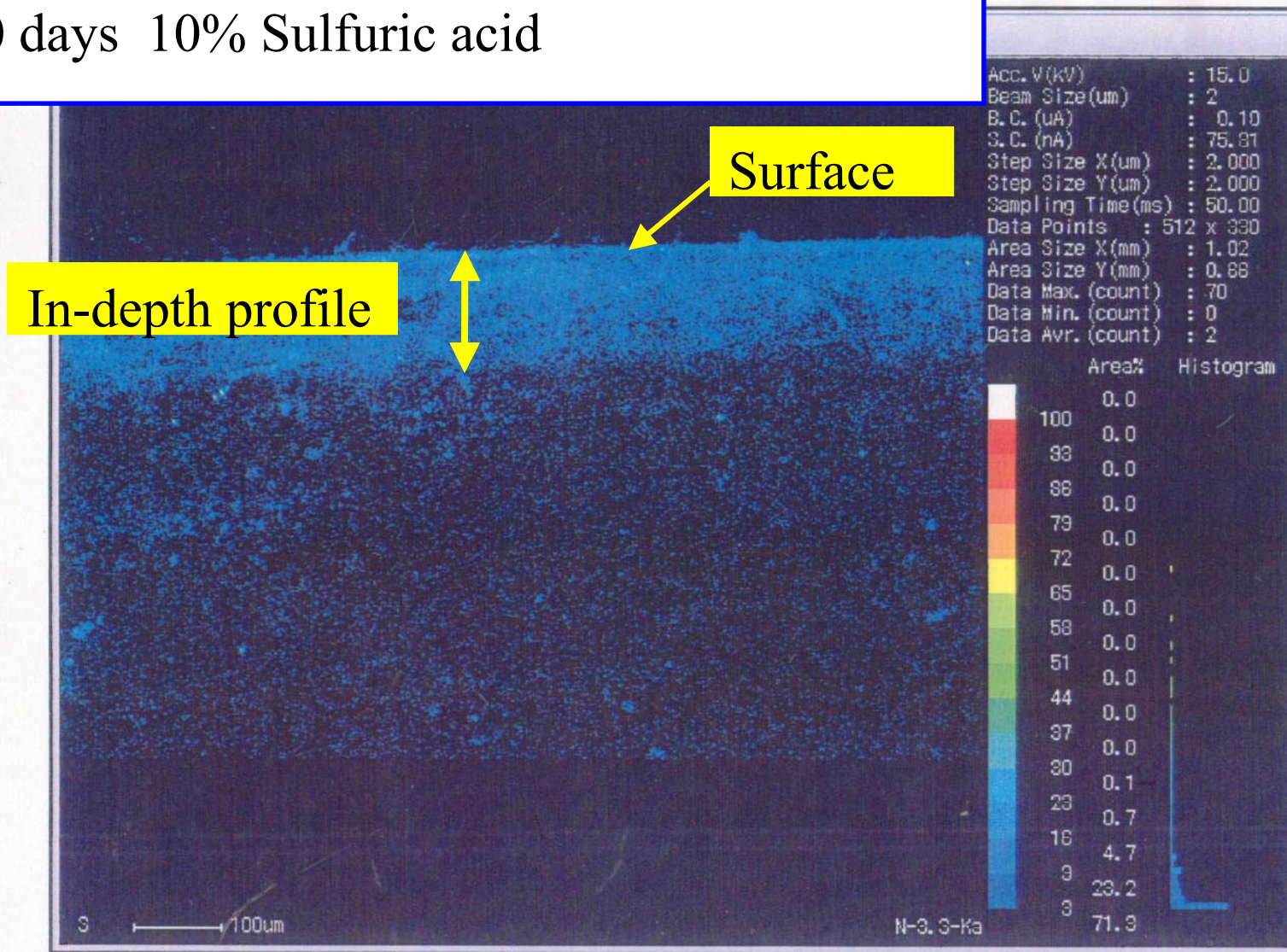
# Old method vs. new internal lining system



New excavation technology, lining system, is the solution for:

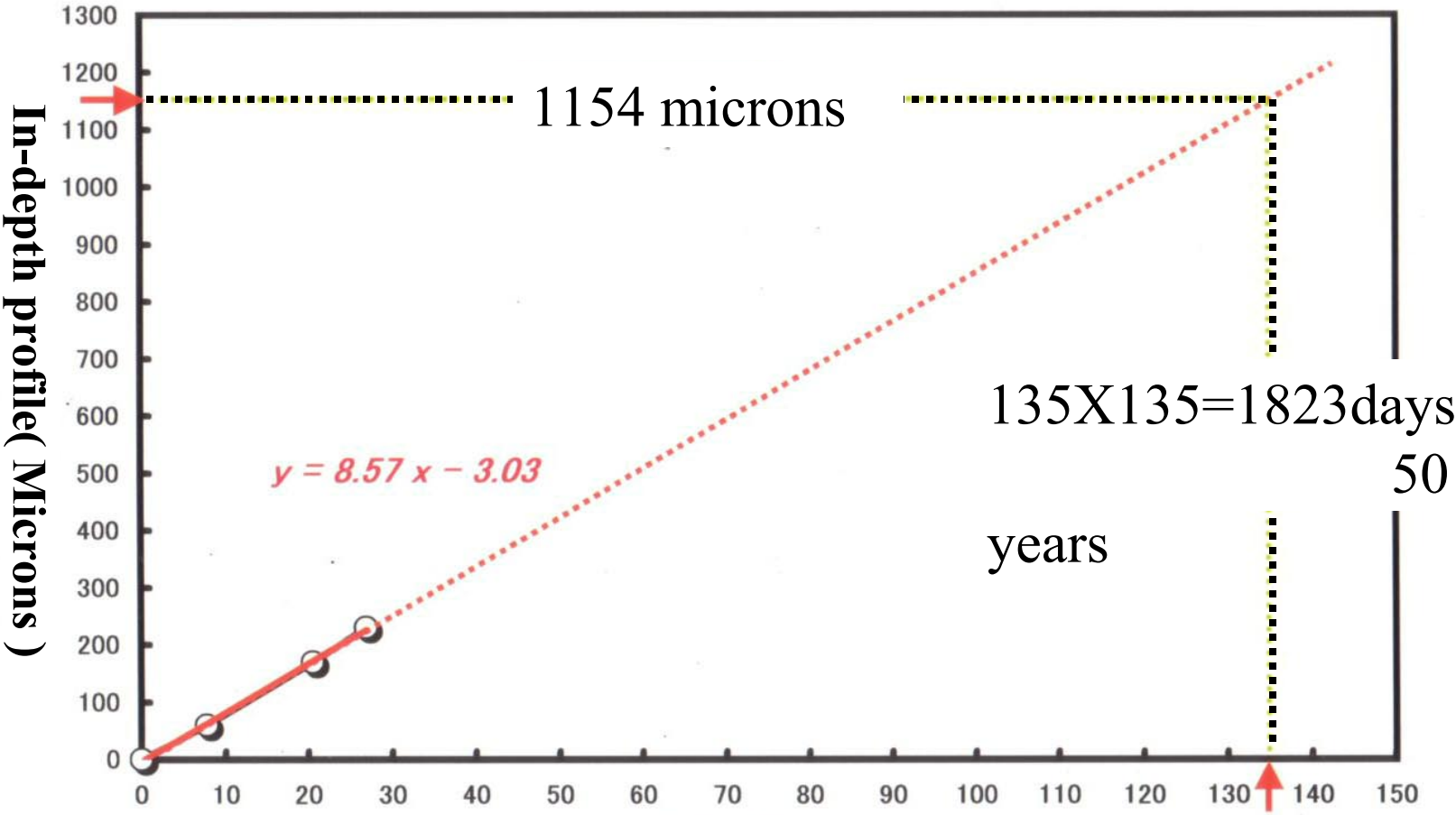
- \* High durability against corrosion and waterproofing
- \* Cost reduction and reduction of total working time from reduction in drill diameter of tunnel

Permeability of Sulfur (EPMA measurement)  
420 days 10% Sulfuric acid



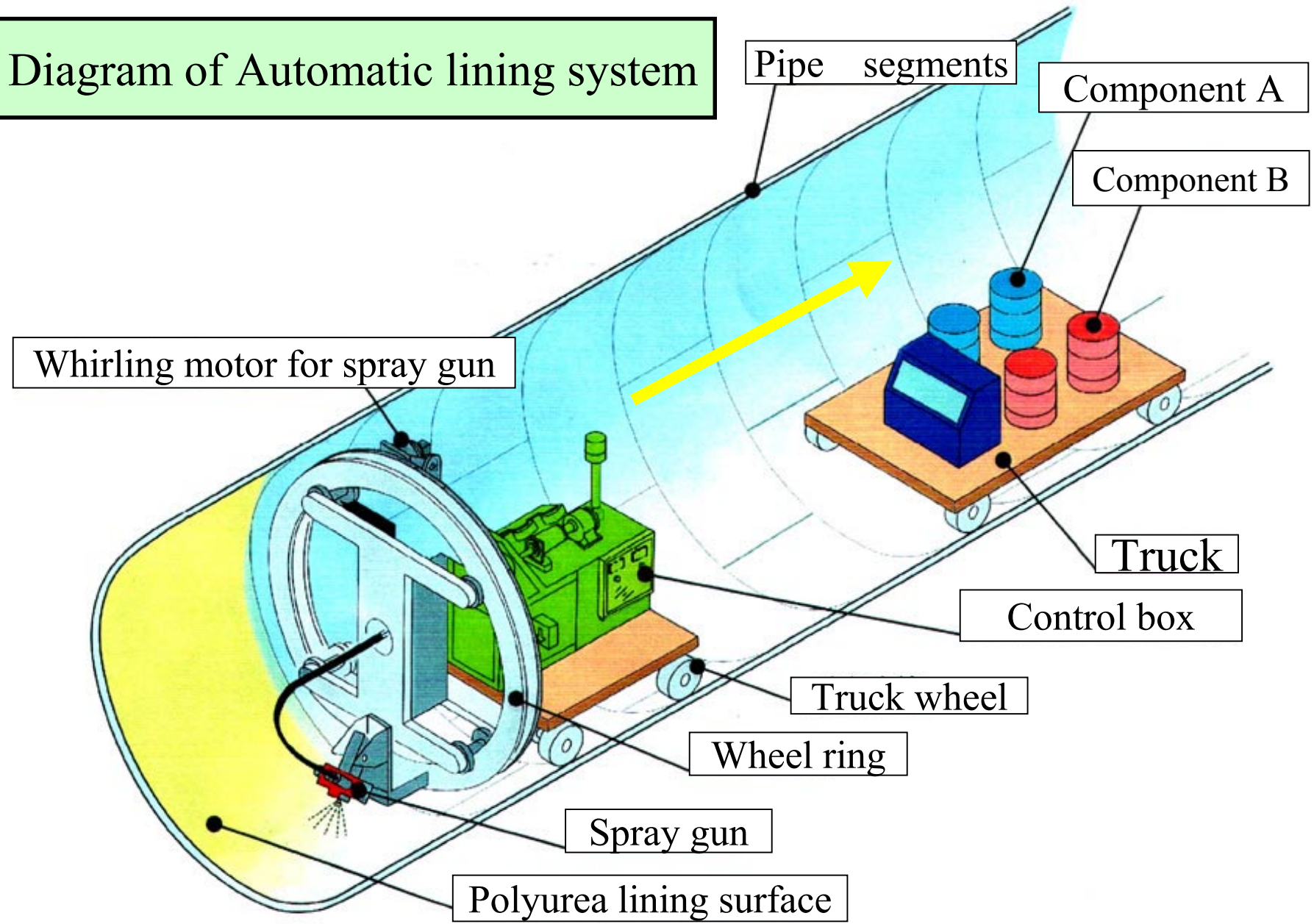
025726 図3 タフガードR-G工法 10w/v% H<sub>2</sub>SO<sub>4</sub>溶液 420日間

# Permeability of Sulfur (EPMA measurement)

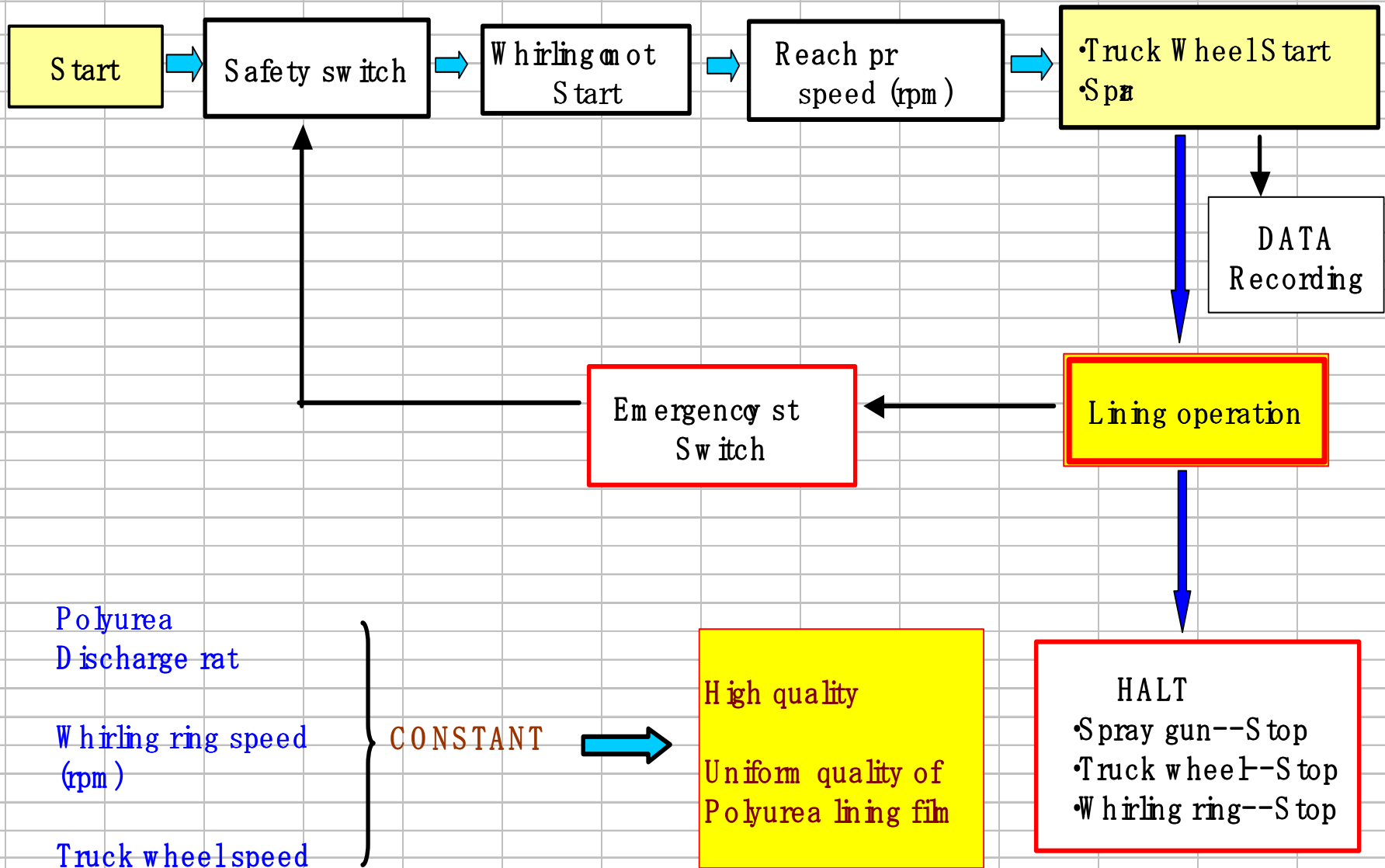


Immersion Time X = Root T (days) in 10% Sulfuric acid

# Diagram of Automatic lining system



# FLOW CHART -- Polyurea NNT Method



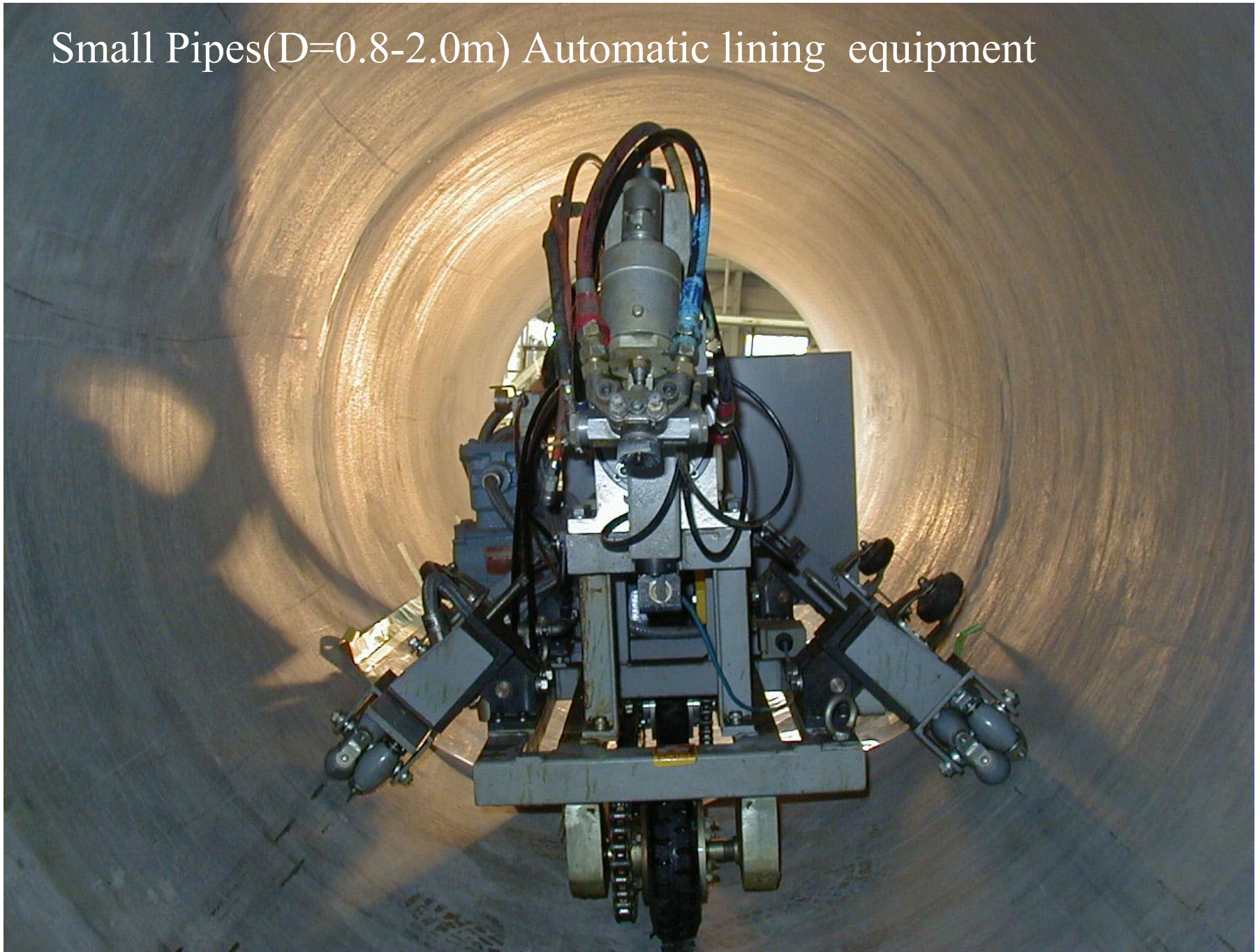
Middle Pipes(D=3-5m) Automatic lining  
equipment  $\phi = 0.8 \sim 2 \text{ m}$



# Middle Pipes(D=3-5m) Automatic Lining Equipment



Small Pipes(D=0.8-2.0m) Automatic lining equipment




# Polyurea NNT Method

Joint R&D by Nippon Kokan Koji/Nippon Paint/Taisei Corporation

Polyurea lining

- \* High durability of Anti-corrosion and Waterproofing
- \* Cost reduction and reduction of total working time

  
*Ultimate efficiency*  


Polyurea NNT Method

Automatic Internal Non-solvent Lining System

- \* Ultimate quality due to uniformity of lining film
- \* Ultimate efficiency due to the Automatic system