

THE IMPROVEMENT OF COATING SHAPE USING THE MULTI SU-F MODEL AND MST METHOD

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Problem Issue

● Roll coater coating process using a material in Slurry (electrode material)

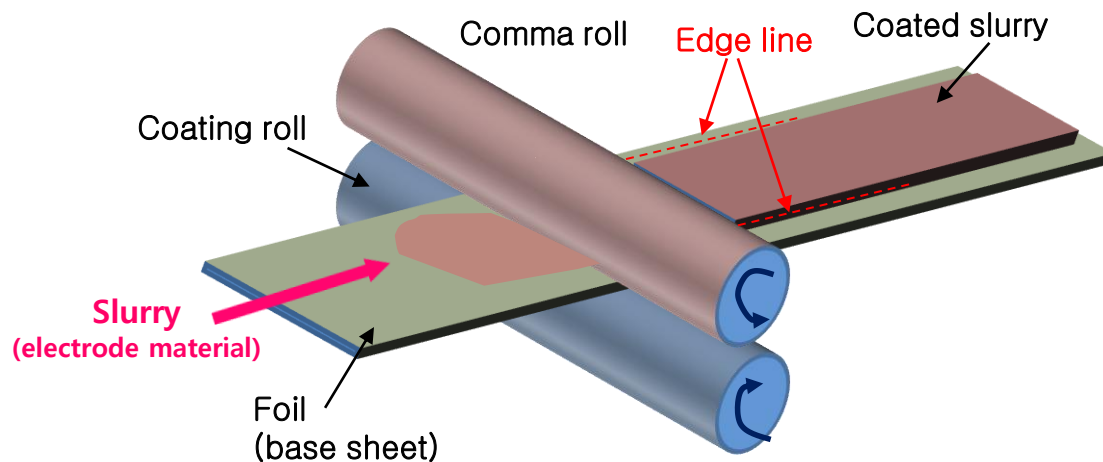
(1) Using the roll coater → Continuously producing and uniform thickness is possible (Useful)

(2) Using a small roll gap → The slurry is spread over the edge line (Harmful)

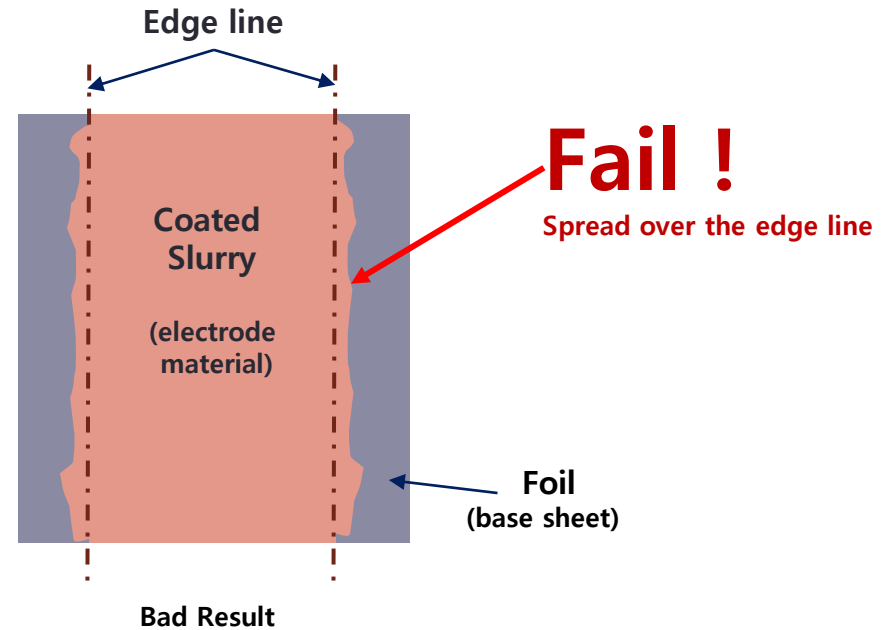
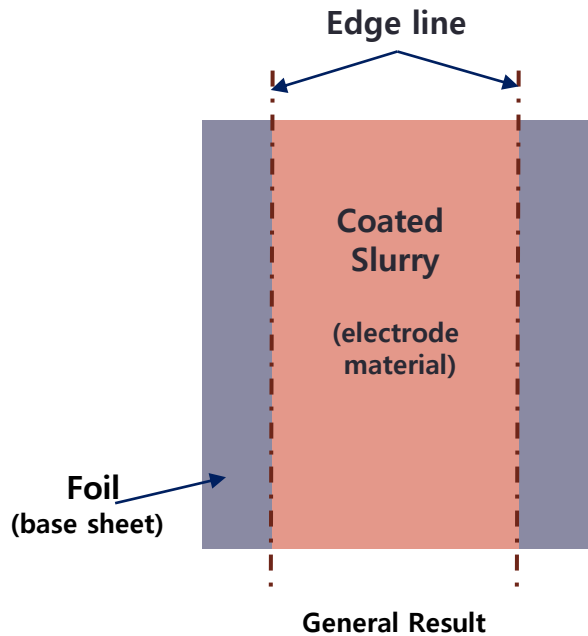
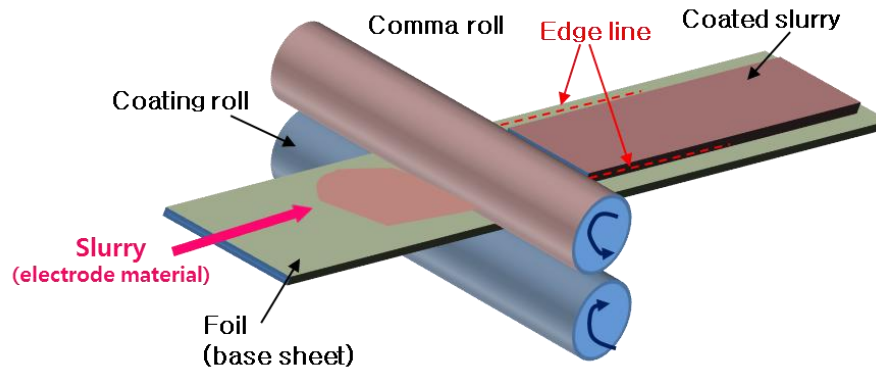
★ Roll coater coating of the electrode material is effective. But the cost is increasing for preventing spread



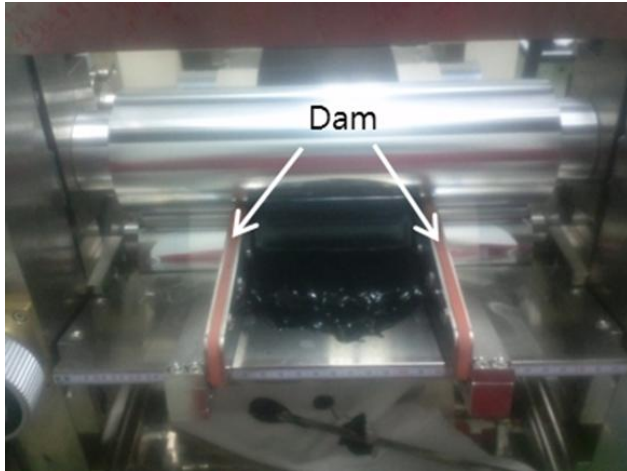
Roll coater (useful) is must be used, but it required additional system (high cost / harmful) for prevent spread of edge line and process control



Problem Issue



Conventional Process



● Roll coater and edge dam (conventional roll coater sys.)

● conventional process and problem

Slurry state electrode material is spreading over the edge line in roll coating process.

- ★ Sudden interruption of the process
- ★ Increasing of process cost
- ★ Maintenance / repair costs increase

need to prevent of slurry spread automatically(self) in continuous coating process!



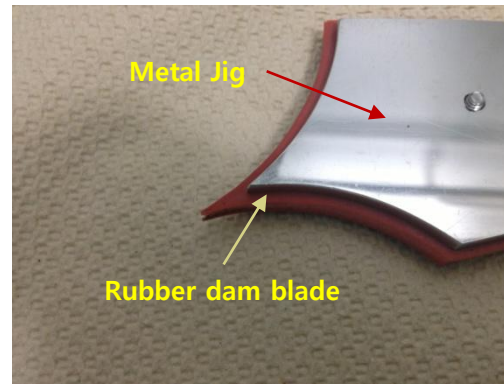
Conventional solution idea

- Using the edge dam → Prevent of slurry spread mechanically useful
- This edge dam is prevented by blocking the spread slurry.
- As time progresses, the effect of edge dam is reduced. Harmful

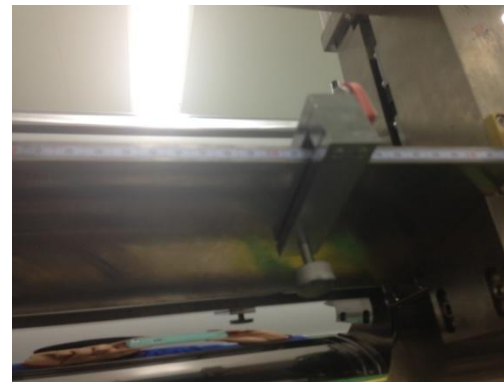
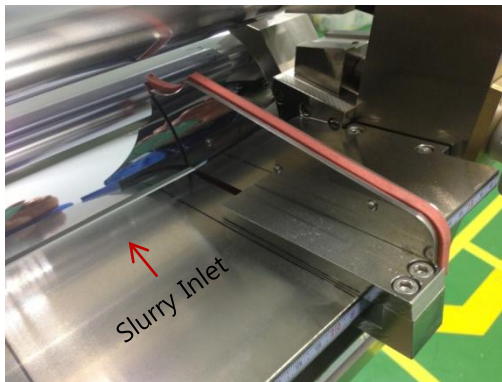
Conventional Process

- conventional solution idea / Edge dam structure

Dam unit images



Dam unit attach images



Problem Define

- The spread problem must have prevented without changing of coater.

(Except edge spreading, the roll coater is useful)

- The spread problem is improved by the strong combined edge dam condition (start condition)
(But, As time progresses → edge dam wetting → slurry spreading / reduce edge dam effect)



Problem 1 : Roll coater is make additional pressure between a slurry and base foil.

→ Excess pressure occurs → Spreading occurring (process contradiction)

Problem 2 : Lower cost and a simple system (Take advantage of existing device)

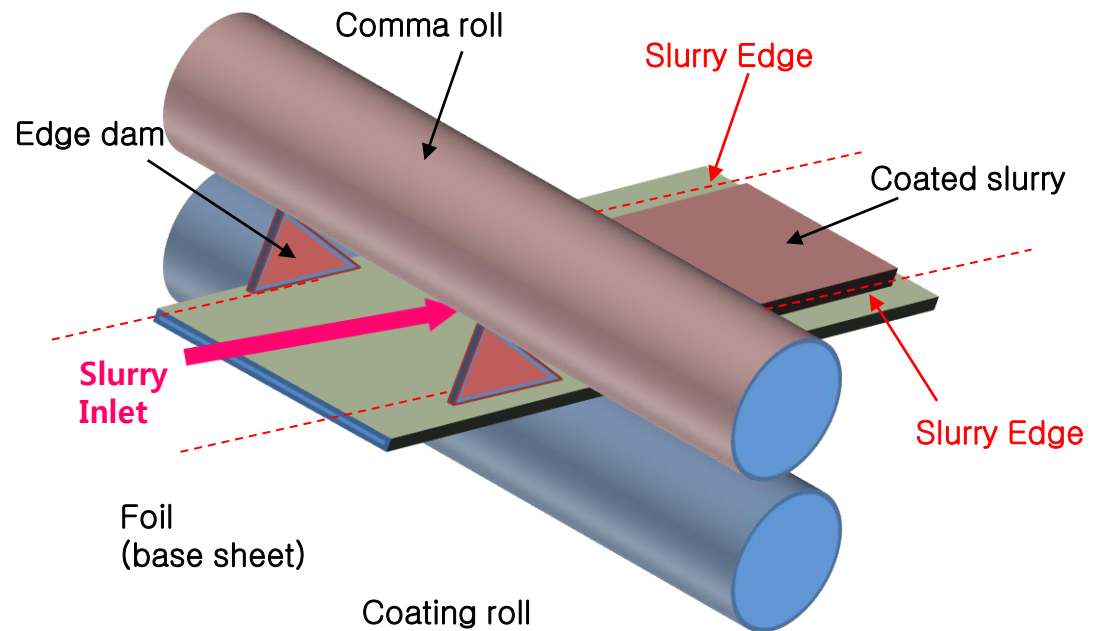
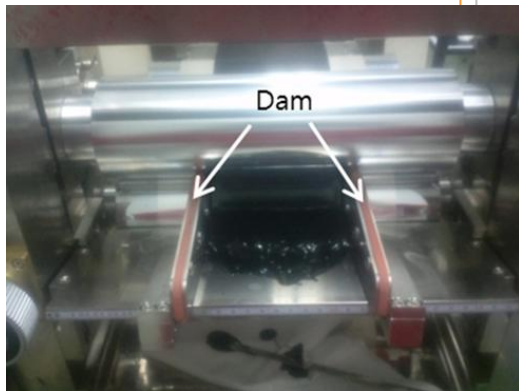
→ There should be no major changes in the existing system



What I want ? : In the coating process, it's required reducing and preventing that slurry spread.

System Analysis

● Simplifying the system / Between parts interaction only

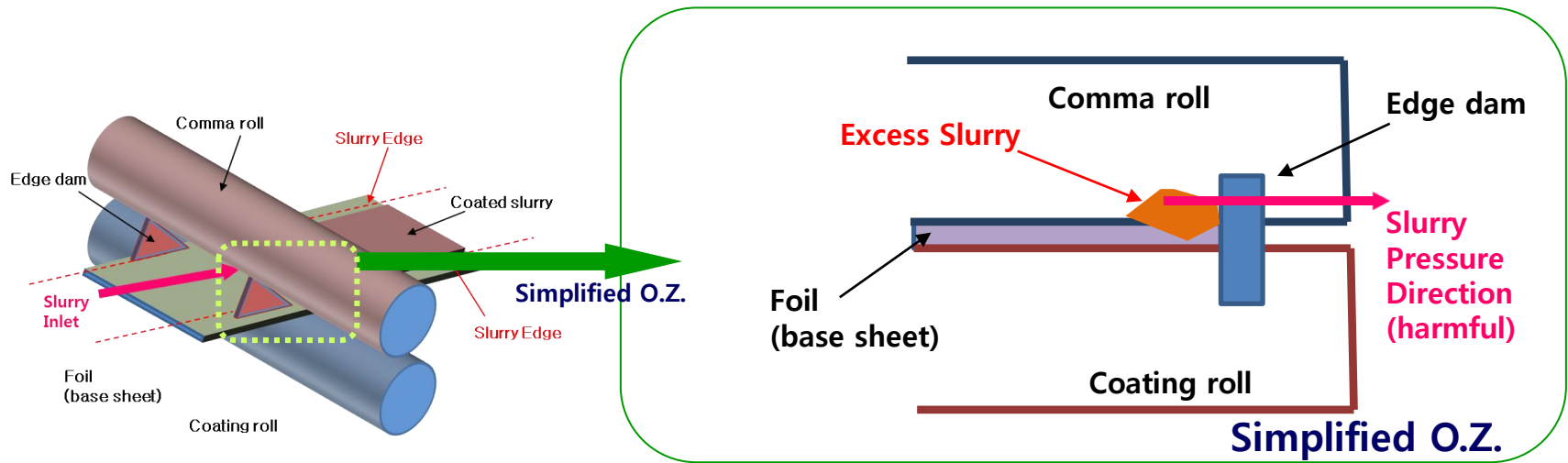


System simplifying

Operation Zone and Resource Analysis

● Operation Zone (O.Z.) : Where the problem occurs?

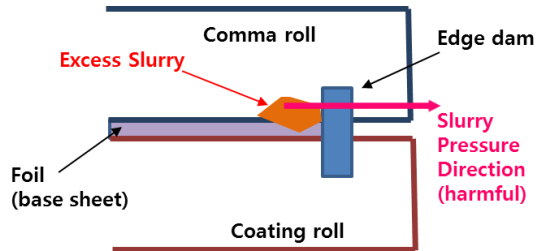
→ must be simplified to interaction system parts only



Resource Analysis

Sub.	F
Comma roll (top roll)	Temperature (T)
Coating roll (Bot. roll)	Pressure (roll pressure)
Edge dam	Pressure (between slurry to edge dam)
Foil (base sheet)	Gravity (g)
Slurry (과잉의)	Friction (between slurry to roll)
	Friction (Slurry to roll)
	Viscosity (Slurry binding force)

Solving problem [1]



Resource Analysis

Sub.	F
Comma roll (top roll)	Temperature (T)
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	Friction (Slurry to roll)
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★ Solving problem in between slurry and edge dam interaction

In Resources, ⁽¹⁾ Larger amount ⁽²⁾ Big cost effect ⁽³⁾ Part of making problem

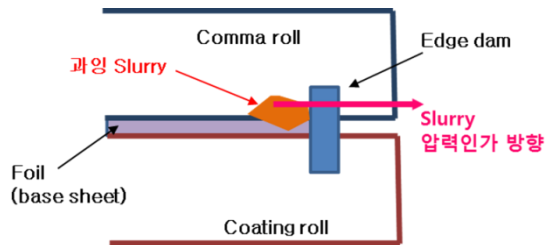
(1) The slurry is most used material, occurring main problem (edge spreading).

(Excess slurry → occurring problem)

(2) The excess pressure is causing the problem. (interaction in slurry and edge dam)

(excess slurry → Accumulates edge dam and roll → roll revolution → making pressure → spreading)

Solving problem [2]



Resource Analysis

Sub.	F
Comma roll (top roll)	Temperature (T)
Coating roll (Bot. roll)	Pressure (roll pressure)
Edge dam	Pressure (between slurry to edge dam)
Foil (base sheet)	Gravity (g)
Slurry (과잉의)	Friction (between slurry to roll)
	Friction (Slurry to roll)
	Viscosity (Slurry binding force)

★ Slurry viscosity, causing pressure problems.

In Resources, (1) Larger amount (2) Big cost effect (3) Part of making problem



(1) The slurry is most used material, occurring main problem (edge spreading).

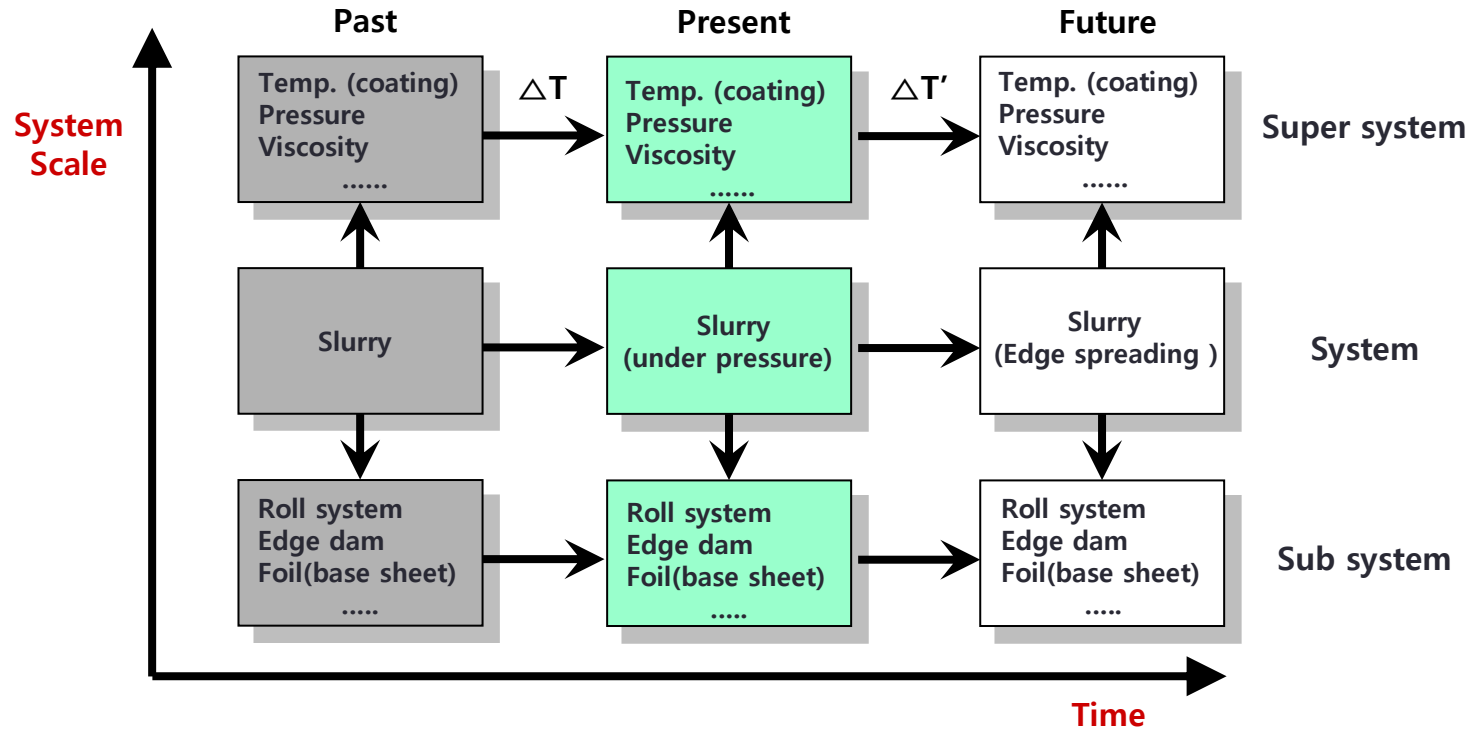
(Excess slurry → occurring problem)

(2) The excess pressure of slurry was generated by viscosity and rotational force of the roll.

(High slurry viscosity → increasing pressure (well accumulates) → pressing edge dam)

MST / Multi Screening Thinking

● Conventional Status

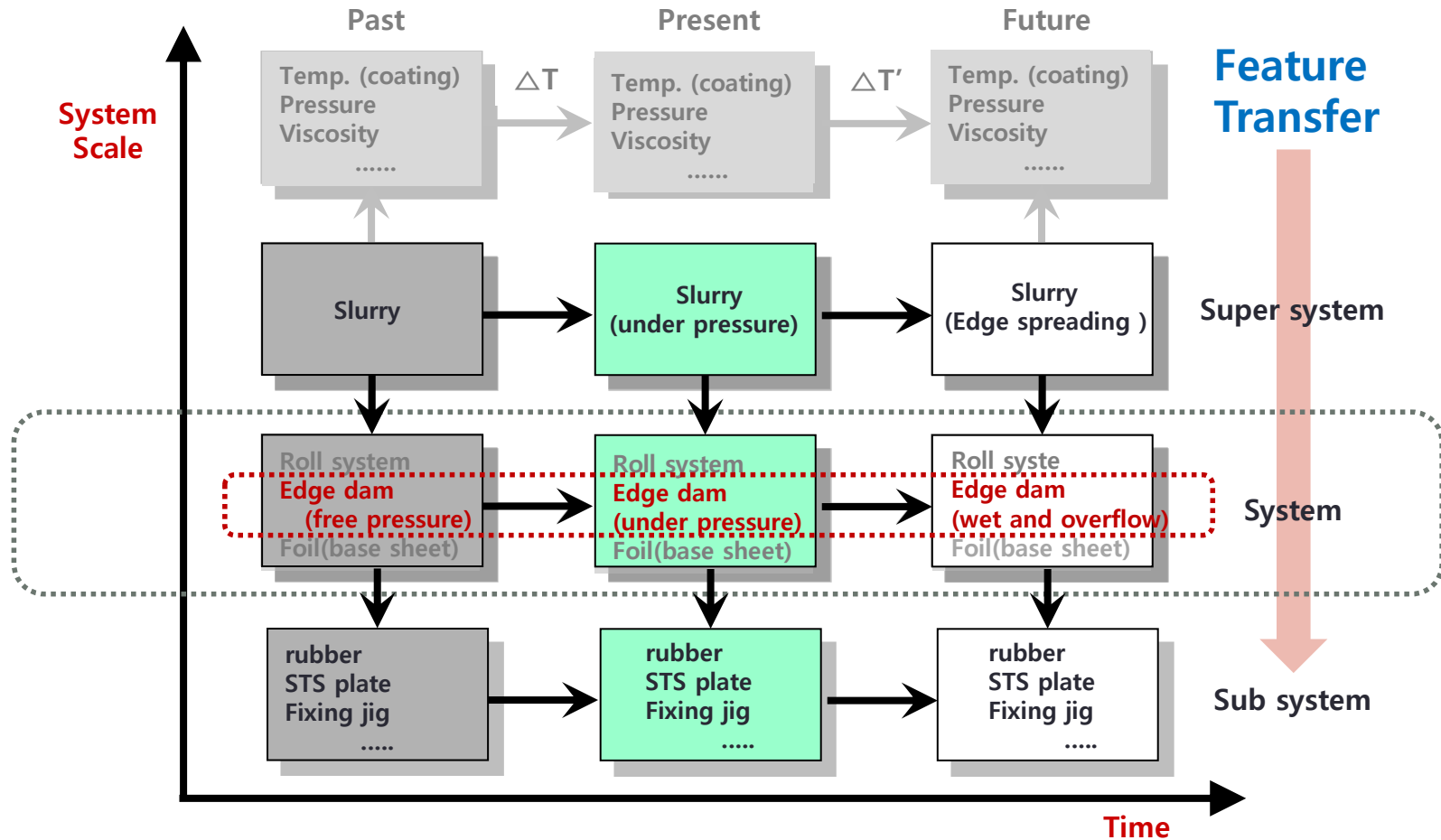


Solution (1)

Solving the interaction of between Slurry to Edge dam

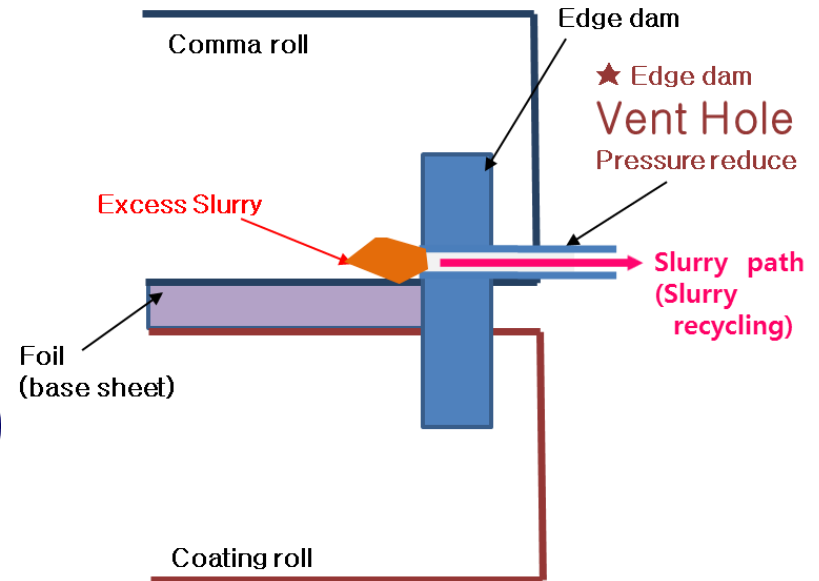
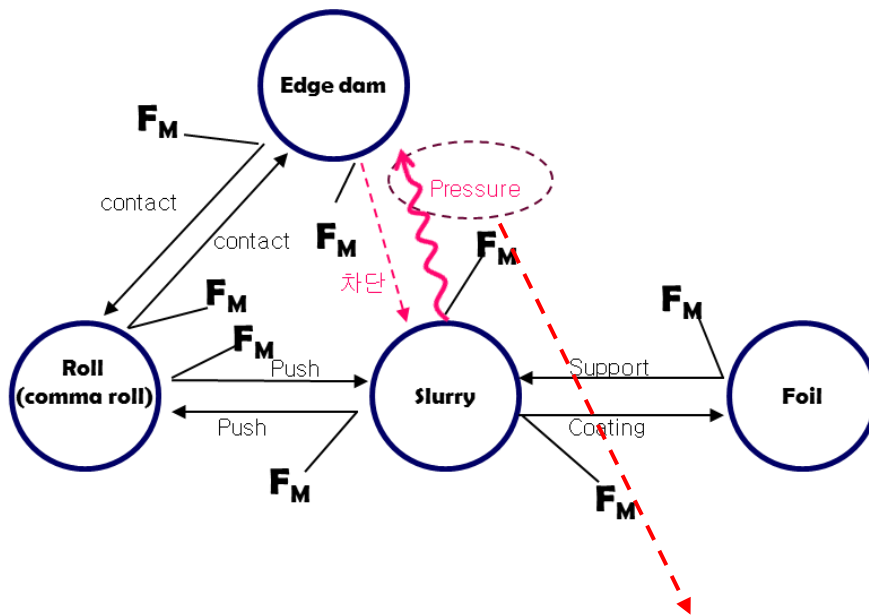
MST / Multi Screening Thinking

● Feature Transferring → Find Problem and Solution



Su-Field Model Analysis and Solution idea[1]

● Su-Field model / Inadequate or harmful factors to improve



★ The excess pressure of slurry must have decreased.

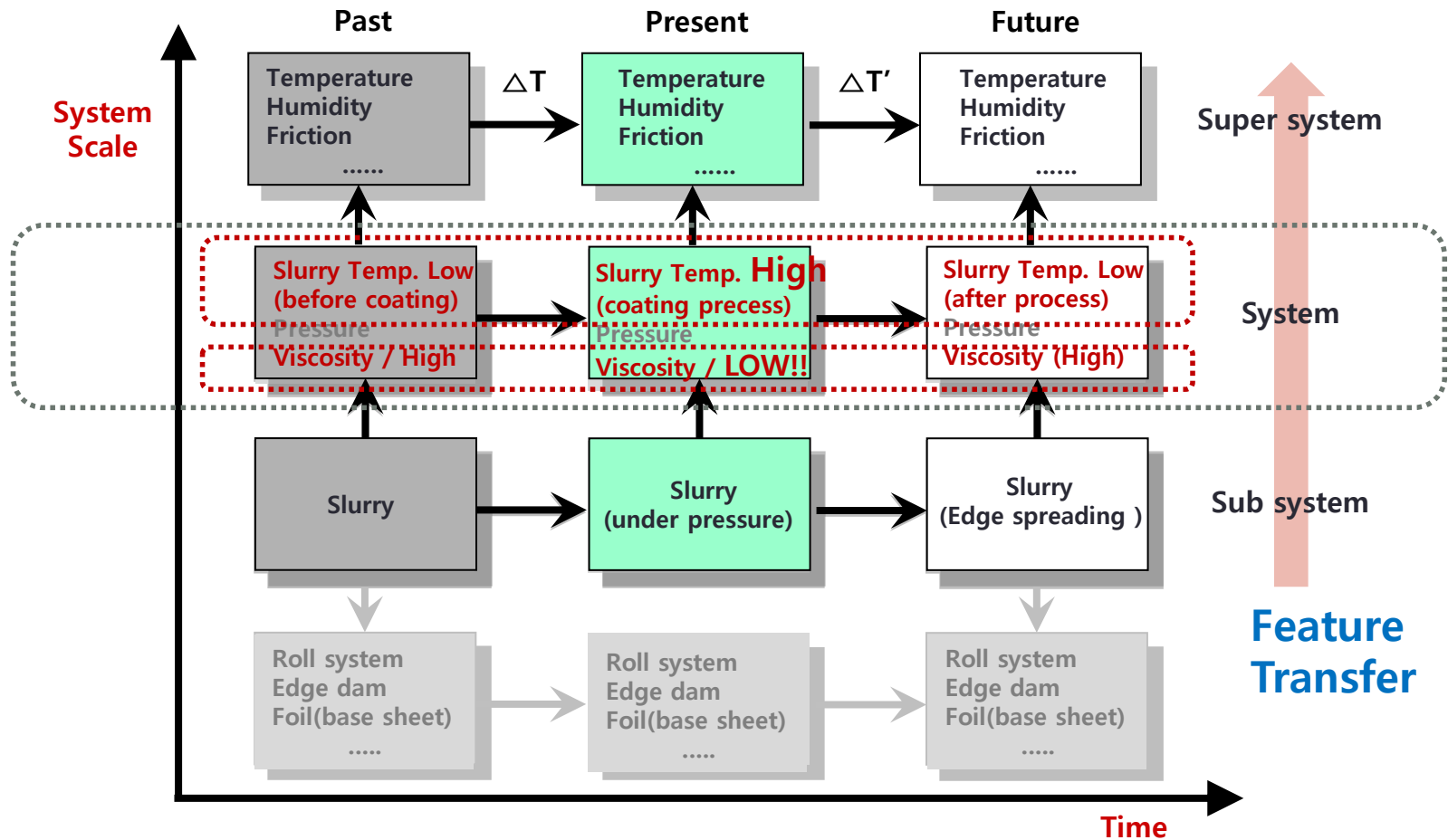
Ideal Final Result : The edge dam having a pressure vent hole structure is required
(There should be no major changes in the existing system.)

Solution (2)

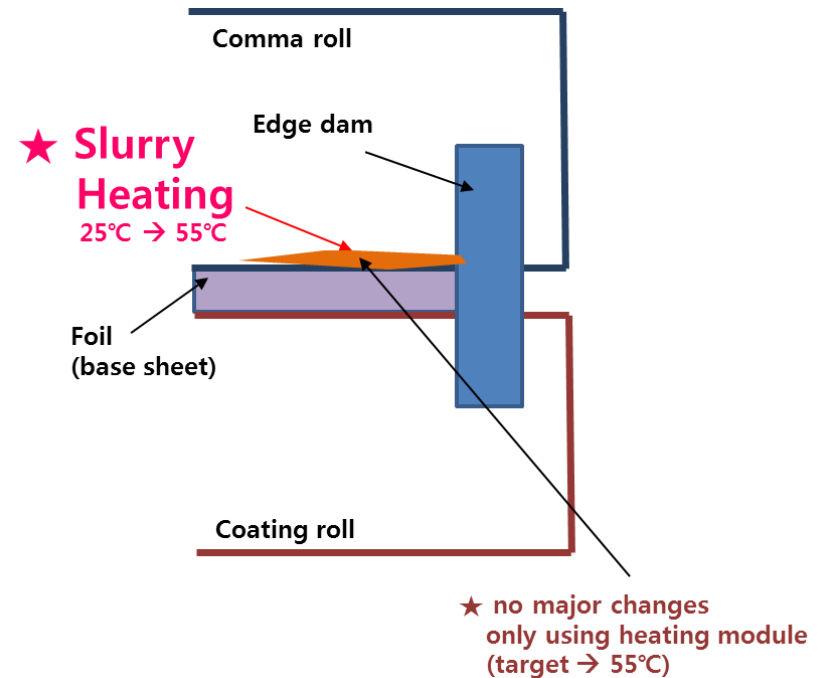
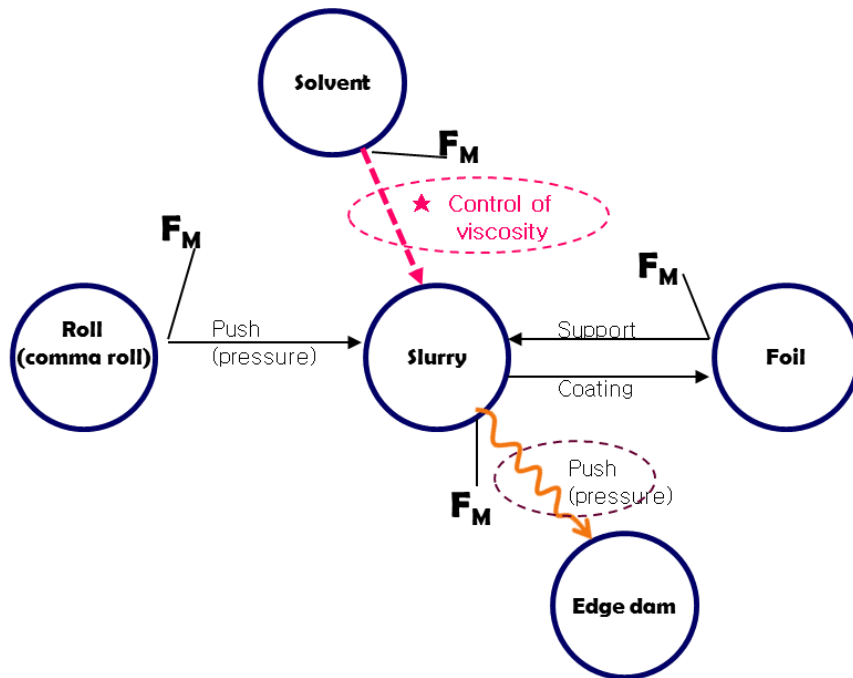
Solving the interaction of between pressure to slurry viscosity

MST / Multi Screening Thinking

● Feature Transferring → Find Problem and Solution



Su-Field Model Analysis and Solution idea[2]



★ The highly viscosity of slurry must have decreased

-The slurry pressure is proportional to slurry viscosity. → viscosity decrease → solving problem

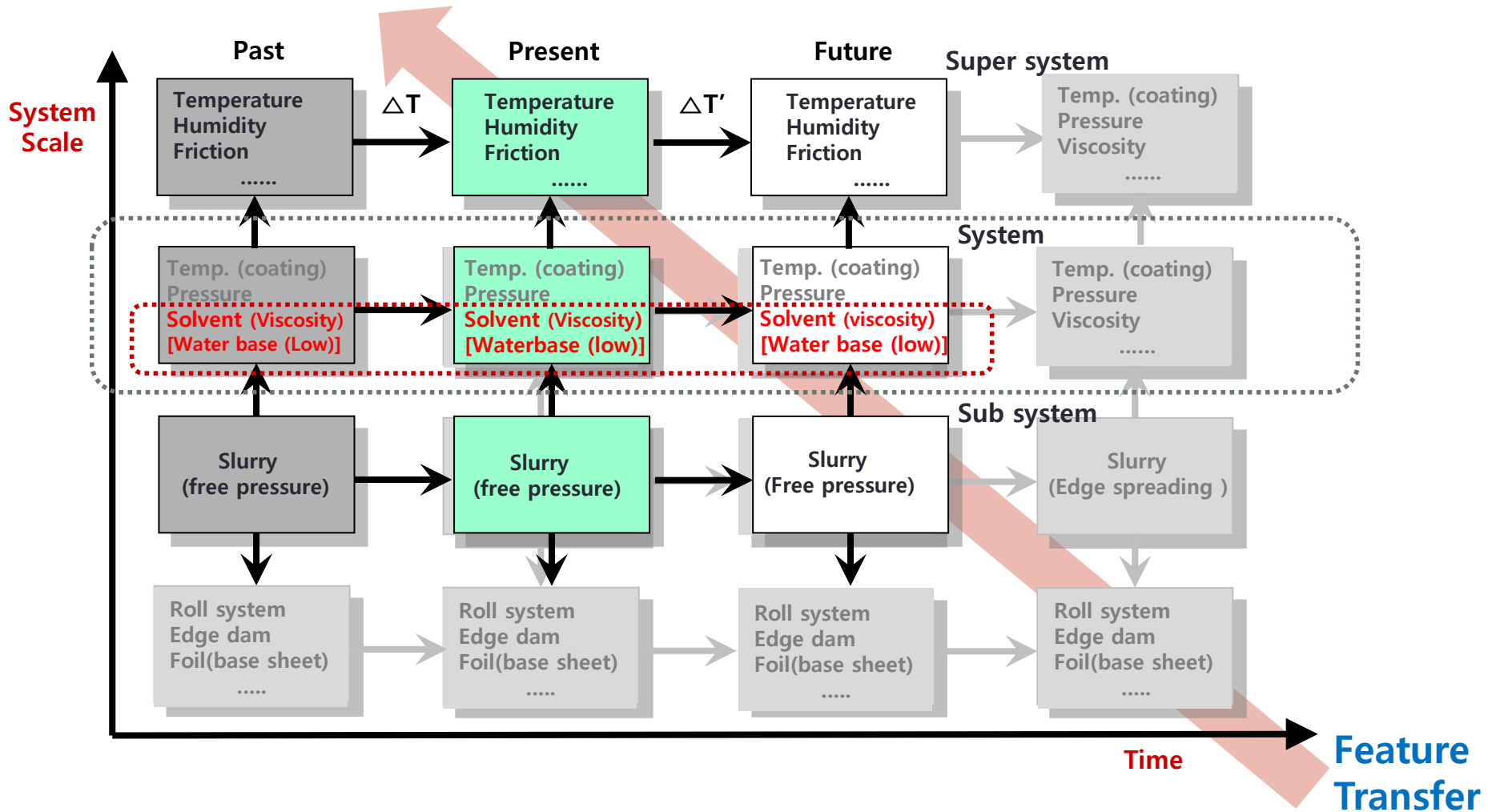
Ideal Final Result : The viscosity must have decreased automatically during coating process.
(There should be no major changes in the existing system)

Final Ideal Solution

Solving the new type solvent for slurry

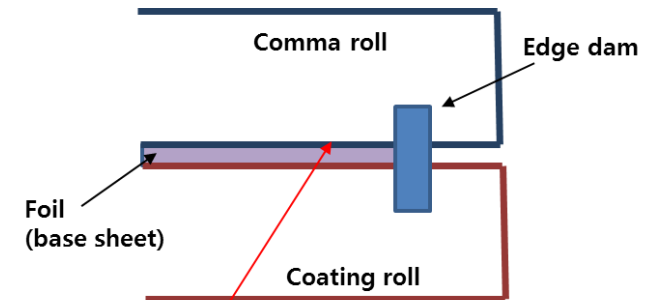
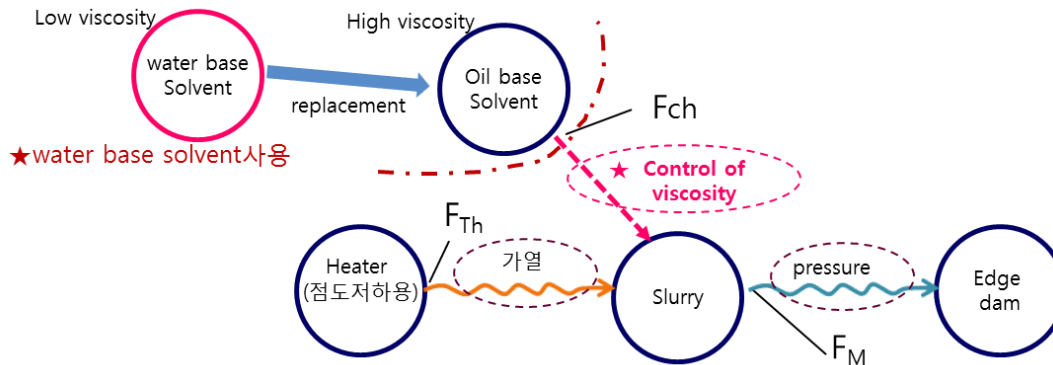
MST / Multi Screening Thinking

● Feature Transferring → Find Problem and Solution



Ideal Final solution

- Problem was solved using the control of pressure and viscosity (solution 1, 2)
- But the solution ideas are required additional system
(pressure vent hole and recycling path, heating module)
- Remove heater, **Improve solvent and slurry viscosity** → Ideal problem solving



Conventional solvent **Oil base**
 → ★ **Water base solvent !**
 -Did not try any change for roll coater
 -ideal problem solving

★ **Viscosity decreases is required** (in room temp.)

→ replace Oil base solvent (12000cps R.T.) → **water base solvent**

Ideal Final Result :

Viscosity of Slurry should be decreased automatically(self) in room temp.

Conclusion

● The spread problem must have prevented without changing of coater.

(There should be no major changes in the existing system.)

→ IFR 1st step : The edge dam having a pressure vent hole structure is required

→ Additional system(edge dam modification) / **vent hole and recycling path**

→ IFR 2nd step : The viscosity must have decreased automatically during coating process.

→ **Slurry Heating** → decrease viscosity

→ IFR final : Viscosity of Slurry should be decreased automatically(self) in room temp.

→ replace Oil base solvent (12000cps R.T.) → **water base solvent**

