WWT experimental automation system

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Chemical Engineering Department

POSTECH

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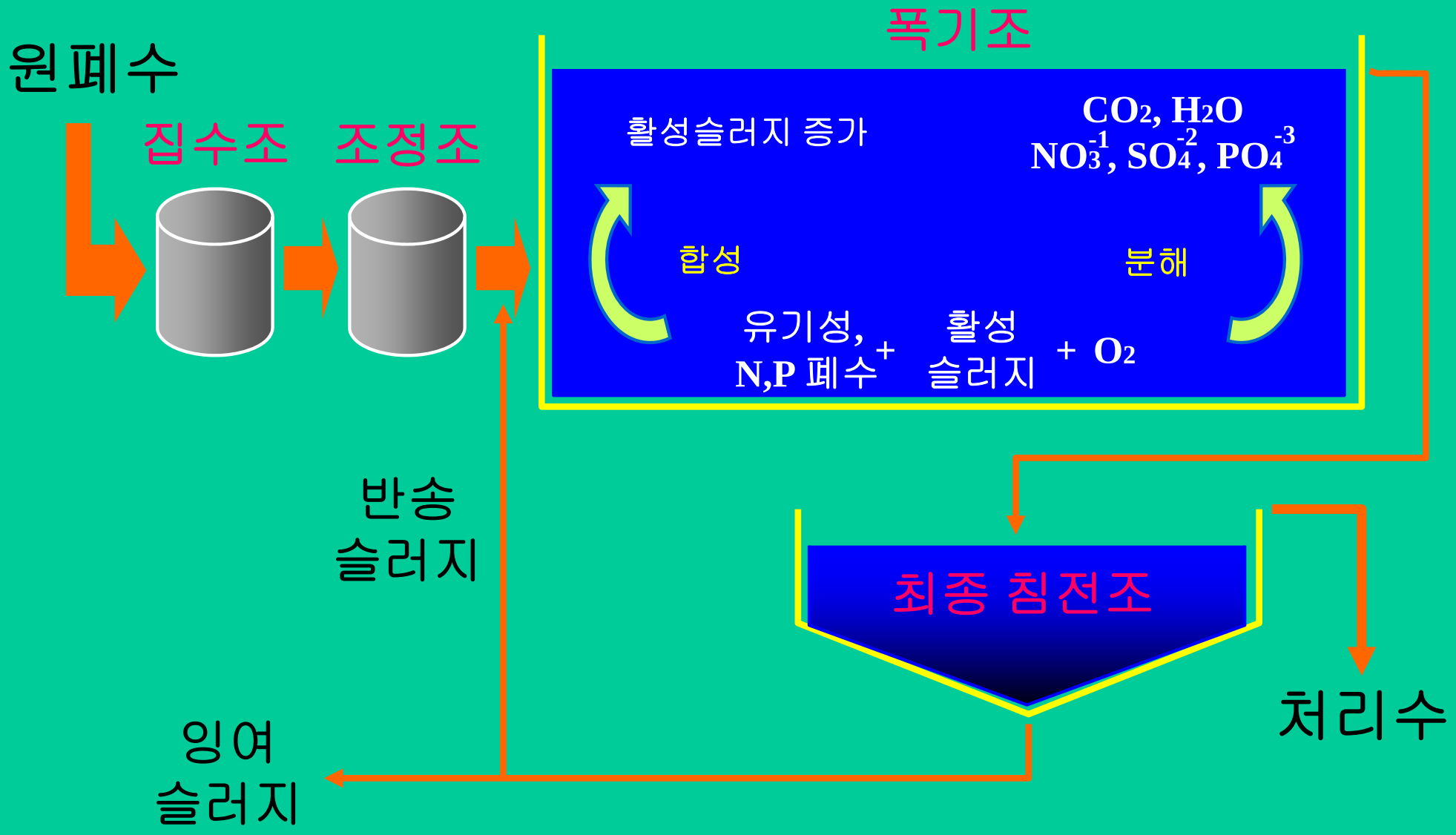
Procedure

- **Activated Sludge Process description**
- **WWT experimental automation system**
- **PC/PLC program**
- **Current state**

활성 오니 공정 개요

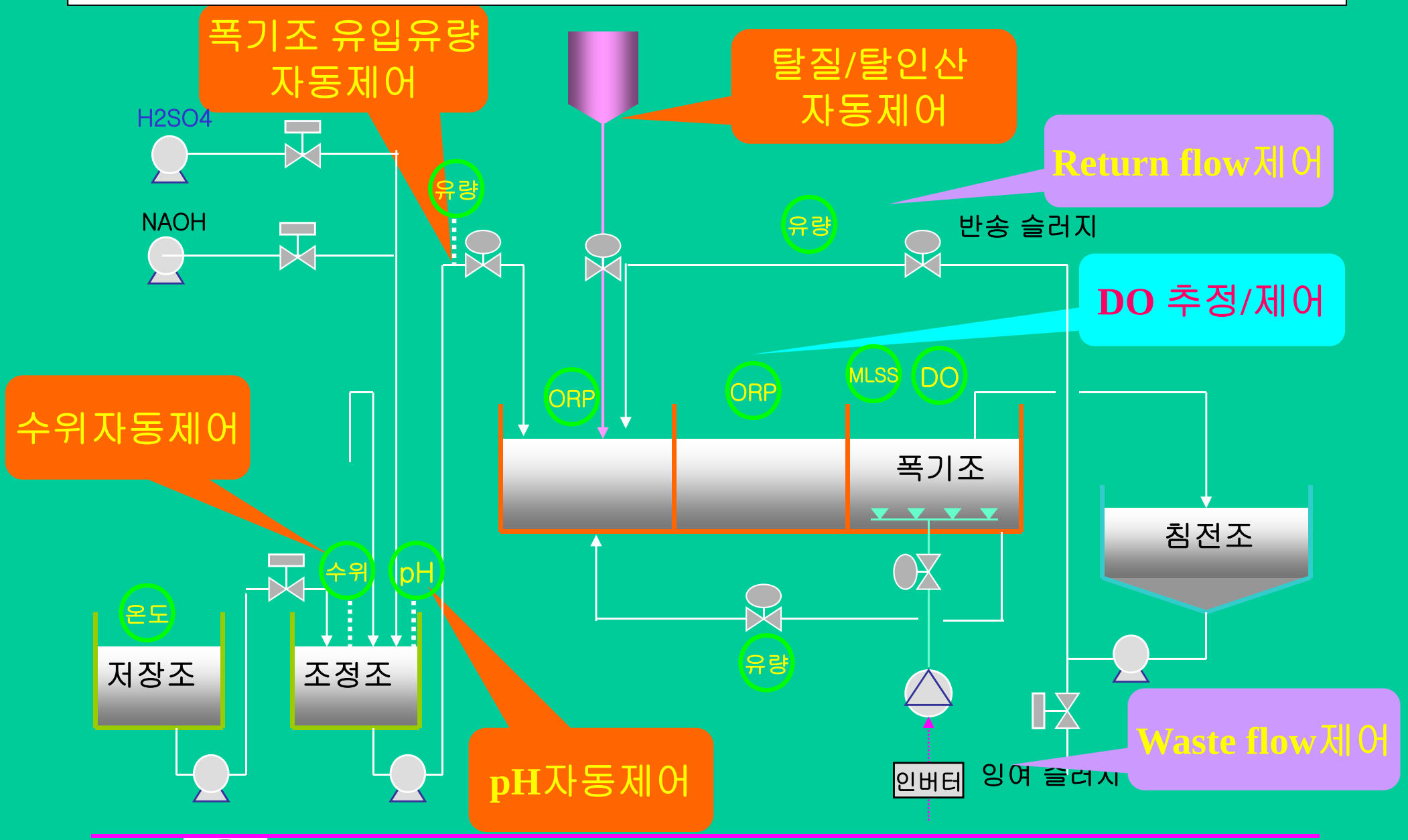

원폐수
집수조
조정조
폭기조
활성슬러지 증가
CO_2, H_2O
NO_3^{-1}, SO_4^{-2}, PO_4^{-3}
합성
분해
유기성, N,P 폐수
+
활성 슬러지
+ O_2
반송 슬러지
최종 침전조
처리수
잉여 슬러지

활성 오니 공정의 장/단점

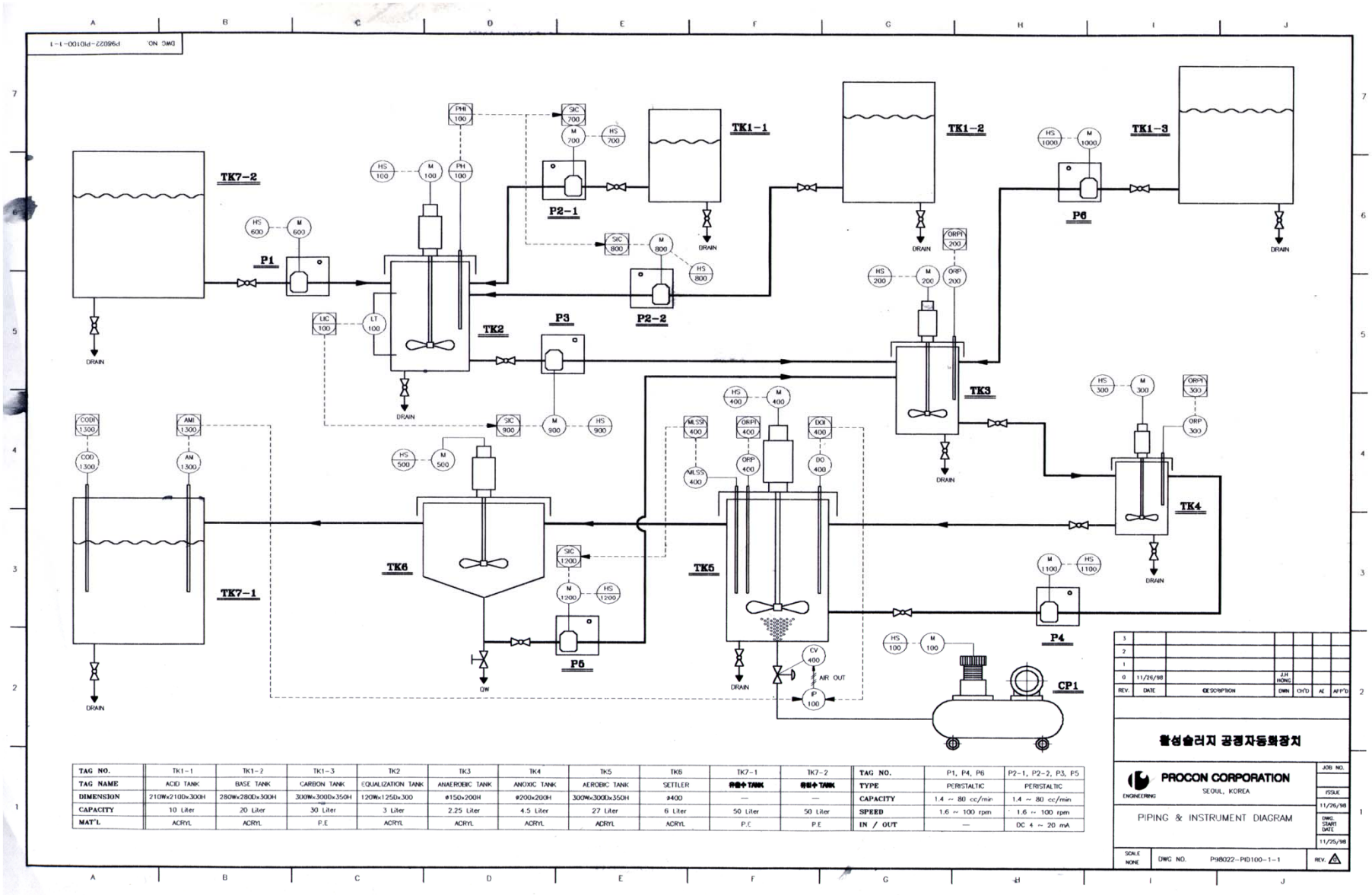
장점	유기성 폐수에 대해 현장에서 검증된 방법
단점	1. 유입수의 유량과 부하의 변동에 약 2. 다량의 슬러지발생 및 높은 처리비 3. 장해 미생물에 의한 Bulking 현상 4. 과다한 Blower 가동전력소비량

운전방법 및 제어알고리듬으로 보완 가능

ASP process control element



WWT Experimental P&ID

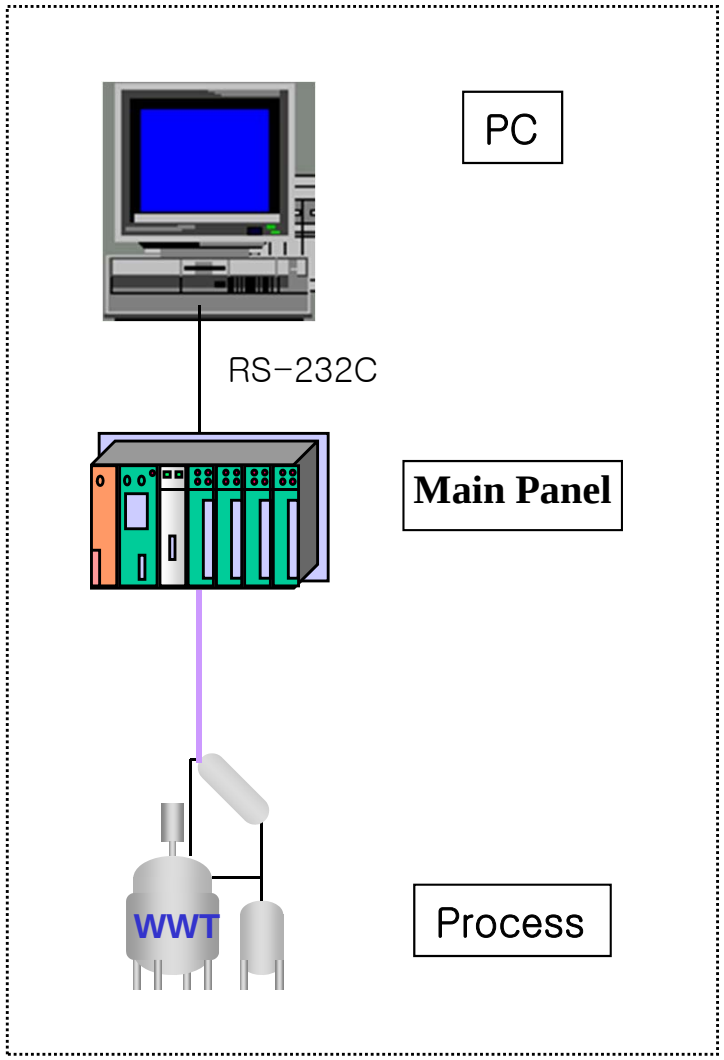


TAG NO.	TK1-1	TK1-2	TK1-3	TK2	TK3	TK4	TK5	TK6	TK7-1	TK7-2
TAG NAME	ACID TANK	BASE TANK	CARBON TANK	EQUALIZATION TANK	ANAEROBIC TANK	ANOXIC TANK	AEROBIC TANK	SETTLER	취출수 TANK	취출수 TANK
DIMENSION	210Wx210Dx300H	280Wx280Dx300H	300Wx300Dx350H	120Wx125Dx300	ø150x200H	ø200x200H	300Wx300Dx350H	ø400	—	—
CAPACITY	10 Liter	20 Liter	30 Liter	3 Liter	2.25 Liter	4.5 Liter	27 Liter	6 Liter	50 Liter	50 Liter
MAT'L	ACRYL	ACRYL	P.E	ACRYL	ACRYL	ACRYL	ACRYL	ACRYL	P.E	P.E

TAG NO.	P1, P4, P6	P2-1, P2-2, P3, P5
TYPE	PERISTALTIC	PERISTALTIC
CAPACITY	1.4 ~ 80 cc/min	1.4 ~ 80 cc/min
SPEED	1.6 ~ 100 rpm	1.6 ~ 100 rpm
IN / OUT	—	DC 4 ~ 20 mA

WWT experiment apparatus

Automation System Architecture



PC
- Control
- Monitoring
- Data storage
- Visual basic

Serial communication

PLC
- M2A CPU
- Data acquisition
- Ladder logic

PLC program architecture

- **PLC : LG's Goldsec**
  - **CPU : M2A**
  - **Communication card**
  - **A/D(16), D/A card(8), D/I, D/O card : 1E/A**
- **Ladder logic with GPPA**
- **A/D, D/A converting**
- **Basic control function**
  - **PID program : velocity form with bumpless conversion and anti-reset windup**

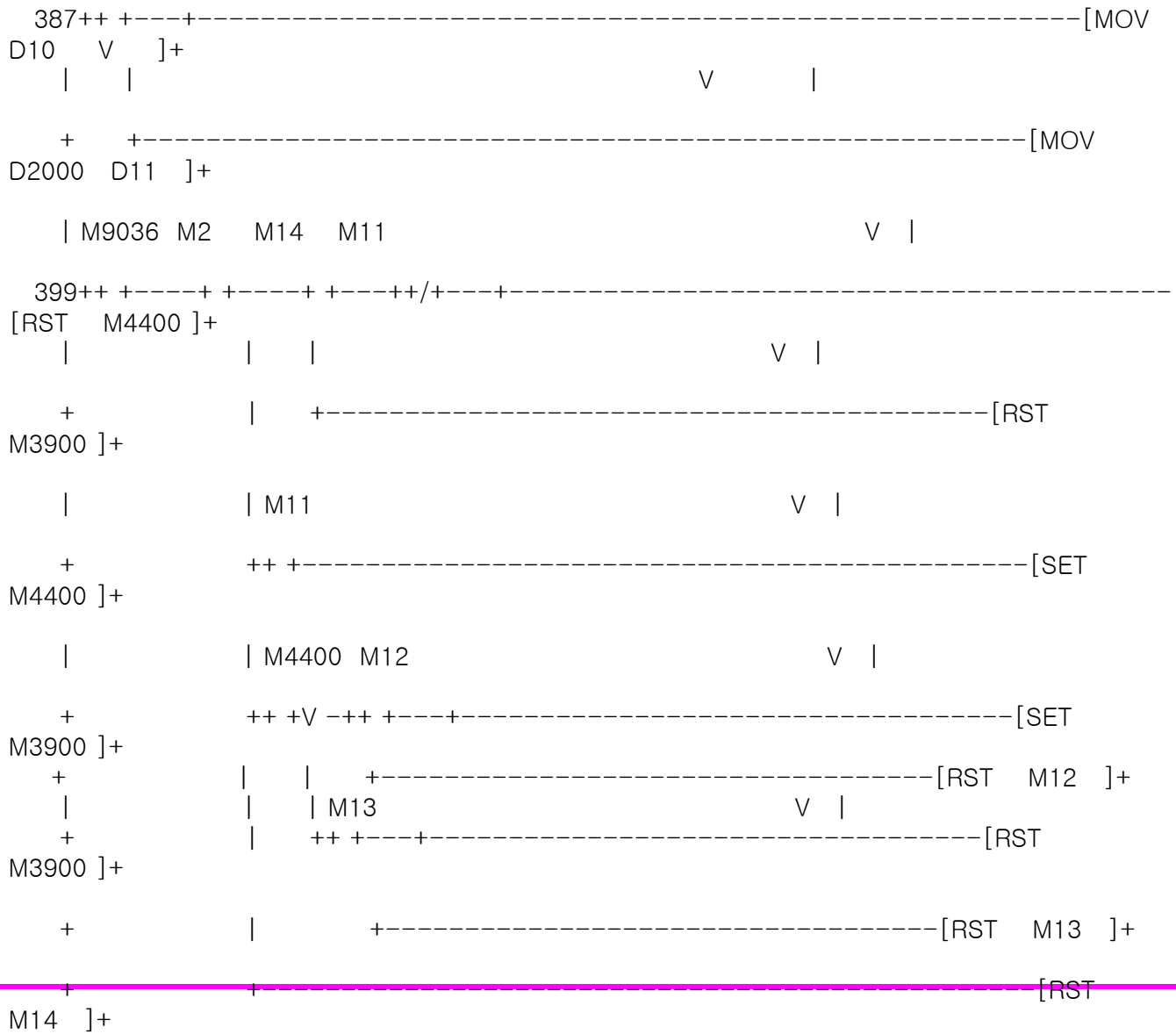
$$\Delta MV = K_p \left\{ (E_n - E_n - 1) - \frac{T_s}{T_I} En + \frac{T_D}{T_s} (2PV_n - PV_{n-1} - PV_{n-1}) \right\}$$

$$\Delta ME_n = SV - PV_n$$

PLC I/O card details

- **A/D card I/O**
  - Pump current flowrate input 6
  - Equalization T/K's pH, Level
  - 3 T/K's ORP 1, 2, 3
  - Aeration T/K's DO, MLSS, current air flowrate
  - Input/Effluent temperature
- **D/A card I/O**
  - Pump flowrate output 6
  - Air flowrate valve position

PLC pragram example



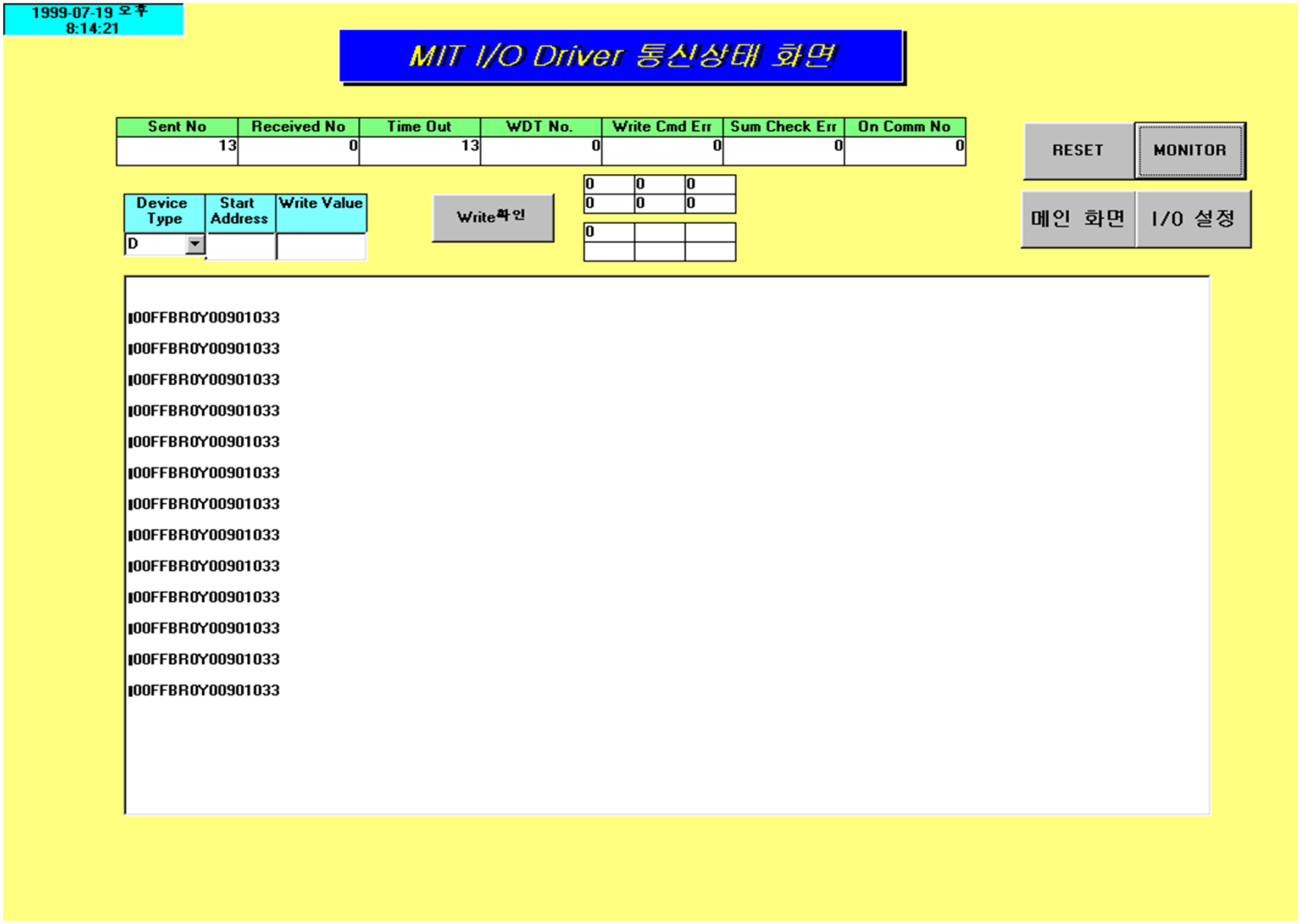
PC program function

- **WWT monitoring function**
  - RS232C communication with Mit PLC
- **Basic control function**
  - PC mode PID algorithm
  - future => Advanced identification and control function
- **Data Storage function**
  - RDB with storage interval (1min)
- **Historical trending function**

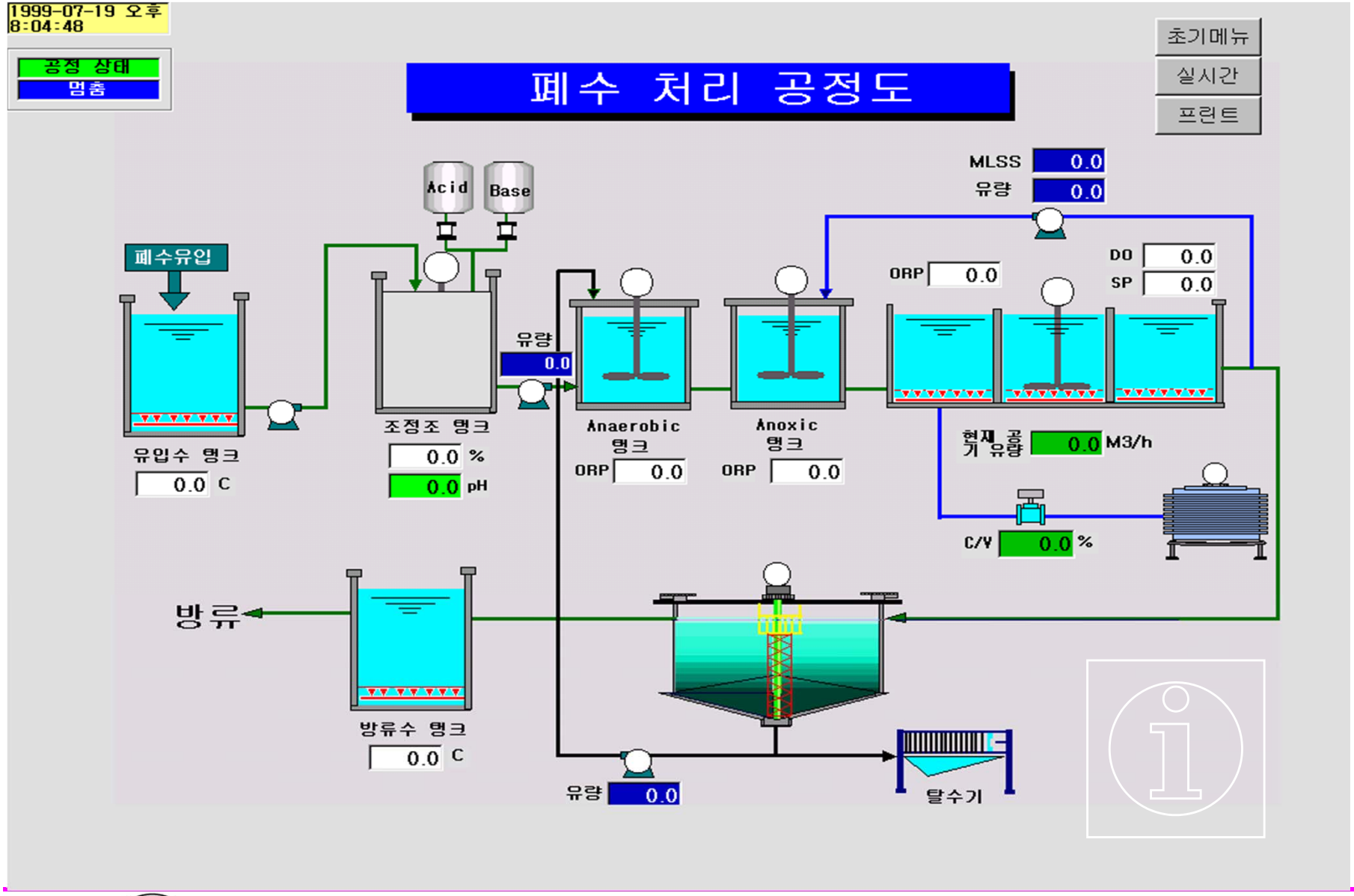
PC program structure

- **Background program**
  - Communication program with PLC
  - Data Storage program
  - PID program within PC mode
- **Foreground program**
  - Data view and graphics
  - Parameter change
  - Historical trending

PC pragram example #1



PC pragram example #2



Future works

- 기타 제어의 **PC/PLC**의 구현 및 추가
- 실험 장비의 실제 구동 및 안정화
- **DO's** 시스템 식별 알고리듬및 제어 알고리듬 적용
- **Simulation**에 기초한 탈질/인산 및 슬러지 제어 알고리듬
- **Data** 해석