My Objective Functions

The system is an adsorption chiller, and I intend to optimise the following objectives first each objective function alone in Single Objective Optimization (SOO), then all objectives simultaneously in multi-objective optimization (MOO). I want to use three optimization algorithms **GWO and MOGWO**; **PSO and MOPSO**; **ANT LION and MOALO**; or any three you are conversant with.

I want the optimal values and plots (Pareto-Fronts, etc.) to show results. Results and figures can be presented in the pdf file UCHE MOO I am sharing. The expected optimal values are shown in parenthesis by the objective functions.

1. Objective 1: Maximize COP **[0.5 – 0.8]**
   The linear regression equations for the performance indicators of the single-stage dual-bed adsorption chiller are as follows:

$$\text{COP} = -1.1469 + 0.0014T_{hw,in} - 0.0085T_{cw,in} + 0.0124T_{chw,in}$$

$$+ 0.0050\dot{m}_{hw} + 0.0099\dot{m}_{cw,bed} + 0.0793\dot{m}_{chw} + 0.0092\dot{m}_{cw,cond}$$

$$+ 5.0687 \times 10^{-6}U_{bed}A_{bed} + 5.2952 \times 10^{-6}U_{evap}A_{evap}$$

$$+ 4.6260 \times 10^{-7}U_{cond}A_{cond}$$

with adjusted $R^2 = 0.8041$

2. Maximize Cooling Capacity, Q_{cc} **[> 16 kW]**
   The linear regression equations for the performance indicators of the single-stage dual-bed adsorption chiller are as follows:

$$Q_{cc} = -64.6199 + 0.3107T_{hw,in} - 0.8625T_{cw,in} + 0.7601T_{chw,in}$$

$$+ 0.6108\dot{m}_{hw} + 0.9944\dot{m}_{cw,bed} + 4.4533\dot{m}_{chw} + 0.5967\dot{m}_{cw,cond}$$

$$+ 0.0006U_{bed}A_{bed} + 0.0003U_{evap}A_{evap}$$

$$+ 2.6623 \times 10^{-5}U_{cond}A_{cond}$$

with adjusted $R^2 = 0.9250$

3. Maximize waste heat recovery efficiency, η_e **[> 0.65]**

$$\eta_e = -0.2347 - 0.0003T_{hw,in} - 0.0019T_{cw,in} + 0.0026T_{chw,in}$$

$$+ 0.0277\dot{m}_{hw} + 0.0034\dot{m}_{cw,bed} + 0.0150\dot{m}_{chw} + 0.0019\dot{m}_{cw,cond}$$

$$+ 2.0286 \times 10^{-6}U_{bed}A_{bed} + 1.0279 \times 10^{-6}U_{evap}A_{evap}$$

$$+ 6.8084 \times 10^{-8} U_{cond} A_{cond}$$

with adjusted $R^2 = 0.8371$

4. Maximize adsorption chiller efficiency, η_{ADC} **[> 0.23]**

$$\eta_{ADC} = -3.0552 - 0.0029 T_{hw,in} - 0.0100 T_{cw,in} + 0.0040 T_{chw,in}$$

$$+ 0.0017 \dot{m}_{hw} + 0.0037 \dot{m}_{cw,bed} + 0.0294 \dot{m}_{chw} + 0.0033 \dot{m}_{cw,cond}$$

$$+ 1.8566 \times 10^{-6} U_{bed} A_{bed} + 1.9477 \times 10^{-6} U_{evap} A_{evap}$$

$$+ 1.6083 \times 10^{-7} U_{cond} A_{cond}$$

with adjusted $R^2 = 0.9630$

(The adjusted R^2 values can be used for the MOO when using weights)

Table 1A: Decision Variables and Bounds

Key Parameters	**Range**	**Units**
Hot water inlet temperature ($T_{hw,in}$)	65 – 95	◦C
Cold water inlet temperature ($T_{cw,in}$)	22 – 36	◦C
Chilled water inlet temperature ($T_{chw,in}$)	10 – 20	◦C
Temperature of outlet chilled water ()	7 – 12	◦C
Hot water mass flow rate of ($\dot{m}_{hw}$)	0.8 – 2.2	kgs− 1
Cool water mass flow rate of ($\dot{m}_{cw}$)	0.8 – 2.2	kgs− 1
Chilled water mass flow rate of ($\dot{m}_{chw}$)	0.2 – 1.4	kgs− 1
$\dot{m}_{cw,bed}$	0.8 – 2.2	kgs− 1
$\dot{m}_{cw,cond}$	0.8 – 2.2	kgs− 1
$U_{bed} A_{bed}$	2,000 – 10,000	W/K
$U_{evap} A_{evap}$	2,000 – 10,000	W/K
$U_{cond} A_{cond}$	10,000 – 10,000	W/K
Cp_w	4.186	kJ/kg K