MECHANICAL DESIGN OF SEAFOOD STOCK MARKET

CIHAN KAYHAN, CAGLAR DINCER, U. BARIS YILMAZ, RAMAZAN HALICI.
Cihan Kayhan, Mechanical Engineer, Yüksel Proje Uluslararası A.Ş,
Çağlar Dinçer, Mechanical Engineer, Yüksel Proje Uluslararası A.Ş,
U. Barış Yılmaz, Mechanical Engineer, Yüksel Proje Uluslararası A.Ş.,
Ramazan Halıcı, Mechanical Engineer, Promek Mühendislik Müşavirlik ve Ticaret Ltd. Şti.

Abstract
In this project; design of trigeneration system with seawater intake structure and estimated costs have been studied for excessive heat gained Gürpınar Seafood Stock Market.
The functions of the areas within the facility determined and than fish entrance and exit areas, fish processing offices, cold storages, maritime museum, auction area, thematic marine cuisine demonstration area as well as social spaces such as cafes and restaurants have been established in the facility.
Heating, cooling and electricity needs of the project provided by trigeneration system, than HVAC systems are designed accordingly. Sea water intake and discharge with chlorination and dechlorination process to be used in the cooling system is summarized in this study with the basic principles.

Introduction
Gürpınar Seafood Stock Market is about 60000 m^2 which is constructed on sea by producing about 170000 m^2 filling area. The Daily capacity of the market is given Table 1.

Daily Capacity	
Total number of vehicles	140
Between 24-5 hours	
Total number of vehicles	120
3,5 tonne capacity frigofric vehicle	*100*
7 tonne capacity frigofric vehicle	*10*
10 tonne capacity frigofric vehicle	*10*

Table 1. Daily capacity.
General view of the market is given Figure 1.

Figure 1. General view.

Design Criteria

Summer-winter thermal comfort conditions for Gürpınar Seafood Market sites are shown in Table 2. The values in the summer and winter comfort conditions table are based on "ASHRAE HVAC Applications Chapter 3 Table-1", "ASHRAE Refrigeration Handbook" and "GIBSE Guide Environmental Design Table 1.1".

No	Site Name	Winter Design Condition	Summer Design Condition	
		Dry-Bulb Temperature DBT	Dry-Bulb Temperature DBT	Relative Humidity
		[ºC]	[ºC]	[%]
1	Receiving	6	6	60
2	Fish entrance	6	6	60
3	Cold room	0-4	0-4	80
4	Freezing room	-35	-35	80
5	Frozen pruduct storage	-18	-18	80
6	Display/Sales	20	24	50-55
7	Offices	20	24	50-55
8	Seminar room	20	24	50-55
9	Restaurant	20	24	50-55
10	Mosque	20	24	50-55
11	Shower	24	-	-
12	WC	18	-	-
13	Dressing room	24	24	50-55
14	Technical center	15	-	-

Table 2. Summer-winter thermal conditions for places.

Minimum fresh air requirement per person and hourly required in Gürpınar Seafood Market Air change numbers are given in the Table 3. Fresh air needs per person "ASHRAE Standard 62.1 - 2007 ".

No	Site name	Min. Fresh Air Quantity[1]			Air Change per Hour	Filtration
		A [l/s.kişi]	B [l/s.m²]	C** [l/s.kişi]		
1	Display/Sales	2,5	0,3	10	-	G4+F6
2	Office	2,5	0,3	10	-	G4+F6
3	Seminar room	2,5	0,3	10	-	G4+F6
4	Restaurant	3,8	0,9	10	-	G4+F5
5	Mosque	2,5	0,3	10	-	G4+F6
6	Shower	-	-	-	10	-
7	WC	-	-	-	10	-
8	Dressing room	-	-	-	6	-
9	Technical center	-	-	-	1-2	-

Table 3. Fresh air needs.
[1] Min. Fresh Air Quantity = A + B
** MMO 297/4
Abbreviations:
F: Bag Filter
G: Panel Filter
The ambient pressures of the places in the building are indicated in the Table 4. Table are based on "ASHRAE HVAC Applications 2007- Part 3 Table-1", and GIBSE Guide A Environmental Design – Part 1 Table".

No	Site name	Ambient Pressure
1	Display/Sales	Neutral
2	Office	Neutral-Positive
3	Seminar room	Neutral
4	Restaurant	Negative
5	Mosque	Positive
6	Shower	Negative
7	WC	Negative
8	Dressing room	Negative
9	Technical center	Negative

Table 4. Places ambient pressure.

Trigeneration System
Heating, cooling and electricity needs of the project provided by trigeneration system. Waste heat (95/80 °C – 900 kW) obtained by the gas engine in the trigeneration system, primarily in the absortive cooling group (step 1) and then in the main building for using in the heating needs of comfort areas (stage 2) from the heat exchange. At 80 °C above the cooling water used to cool the gas engine, sea water (25/30 °C) will be used to prevent water from coming (step 3). Trigeneration Flow Chart shows on Figure 2.

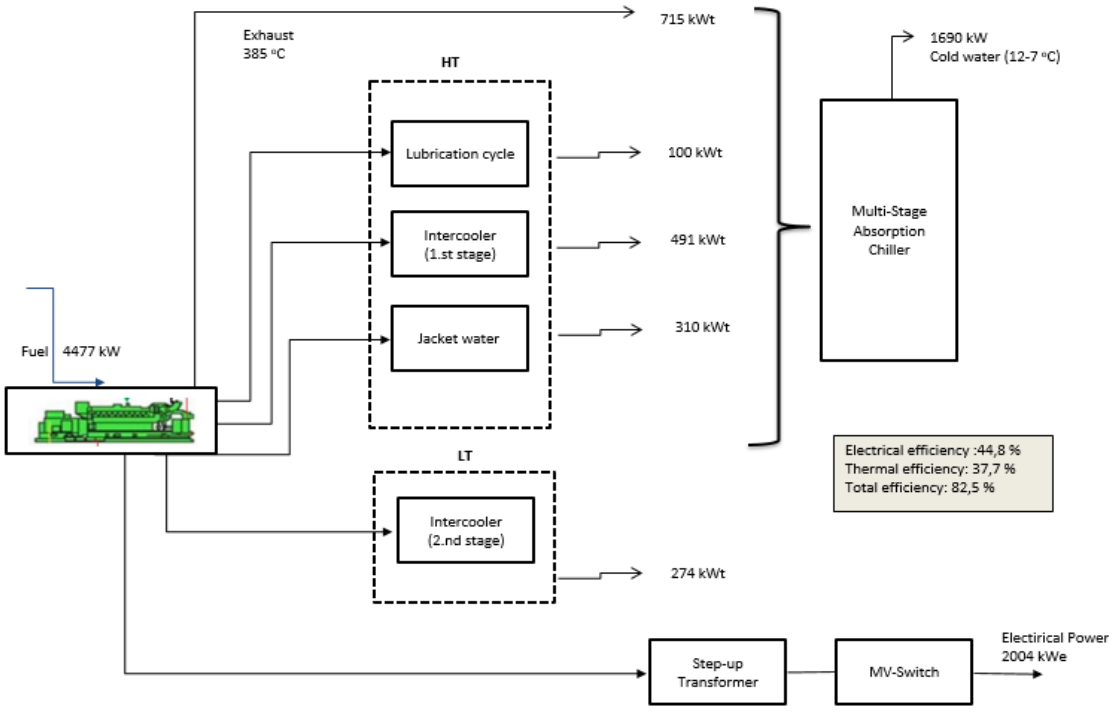


Figure 2. Trigeneration Flow Chart.

The cooling water in the 7/12 ° C water regime will be obtained with the absorbed cooling group in the trigeneration system. The cooling capacity of the gas engine to which the absorbing cooling group is connected has increased by 1,690 kW according to the waste heat.

On the annual maintenance days of the trigeneration system and in the main building mechanical room for water and 4 pipe heat pumps are used. Boiler (70/50 ° C) when the water temperature of the loop circuit is lower than 20 ° C and sea water (25/30 ° C) when the water temperature is above 30 ° C, 30 ° C) exchanger it will be activated.

Systems benefiting from sea water;
1. Removal of Heat from Gas Engine - Sea Water Flow: 35 m^3 / h
2. Removal of Heat from Absorption Cooling Group - Sea Water Flow: 578 m^3 / h
3. Cooling of Heat Pumps Loop Cycle - Sea Water Flow: 229 m^3 / h
4. Cold Room Cooling (Ammonia + Glycol) System - Sea Water Flow: 1,100 m^3 / h

The plates of the exchangers using sea water will be made of titanium material. sea water Using two-way motorized valves in the cycle, the need for seawater desalination. Thus, sea water pumps (frequency controlled) unnecessary energy consumption will be avoided.

Seawater Intake and Discharge Systems

Chlorination system

The inner wall of the water intake pipes from the sea and the outer wall of the heating / cooling system for the destruction of sticky sea creatures (black mussel, moss etc) It is recommended that the amount of chlorine should be 0.5-1.0 g / m^3 (White, 1999). To access this amount in the water intake line, the amount of chlorine to be given to the mouth of the water intake pipe will change, depending on the amount of foreign matter that seawater drinks. The chlorination system P & ID has been given Figure 3.

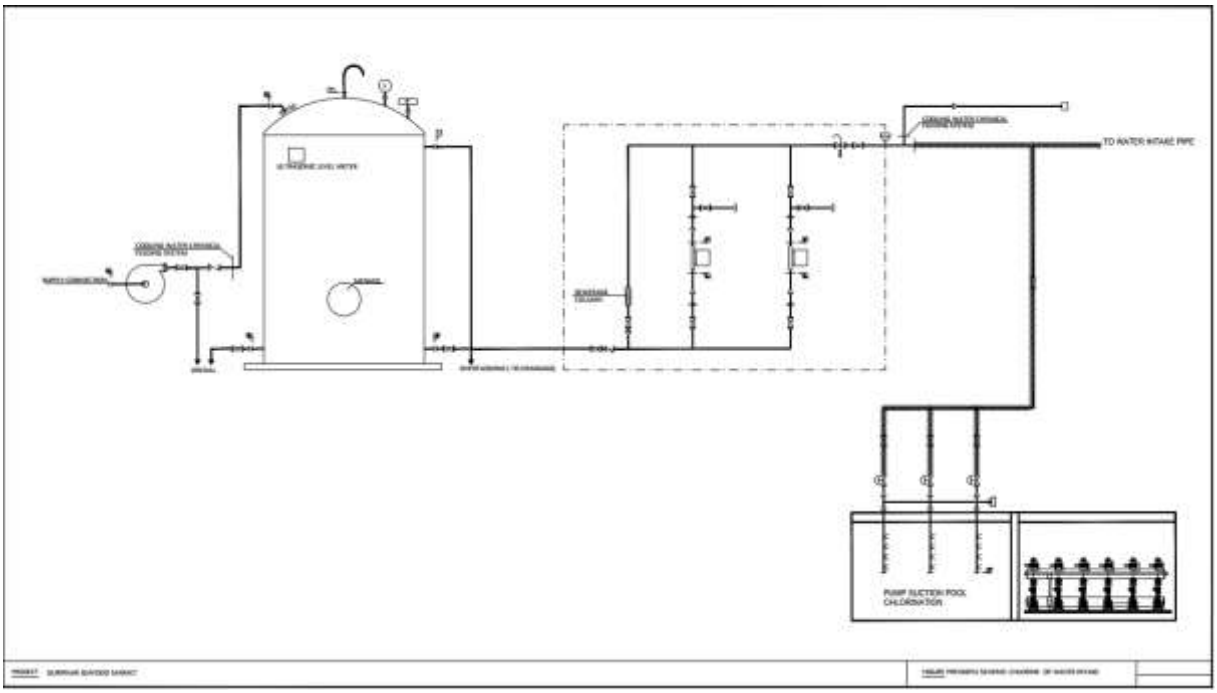


Figure 3. The chlorination system P & ID

Dechlorination system

Chlorine removal will be carried out over the sea discharge pipe to be used for chlorine removal. SO_2 will be used for this operation. Schematics of dechlorization system shows on Figure 4.

SO_2 is normally present as liquid under pressure. At room temperature, it is in gas form. It is colorless in its gas form and has a strong odor at a noticeable level. Liquid form is colorless and transparent.

SO_2 is not corrosive when there is no humidity and at stable room temperature. However, when moisture is present it becomes corrosive and forms sulfuric acid. It is not flammable.

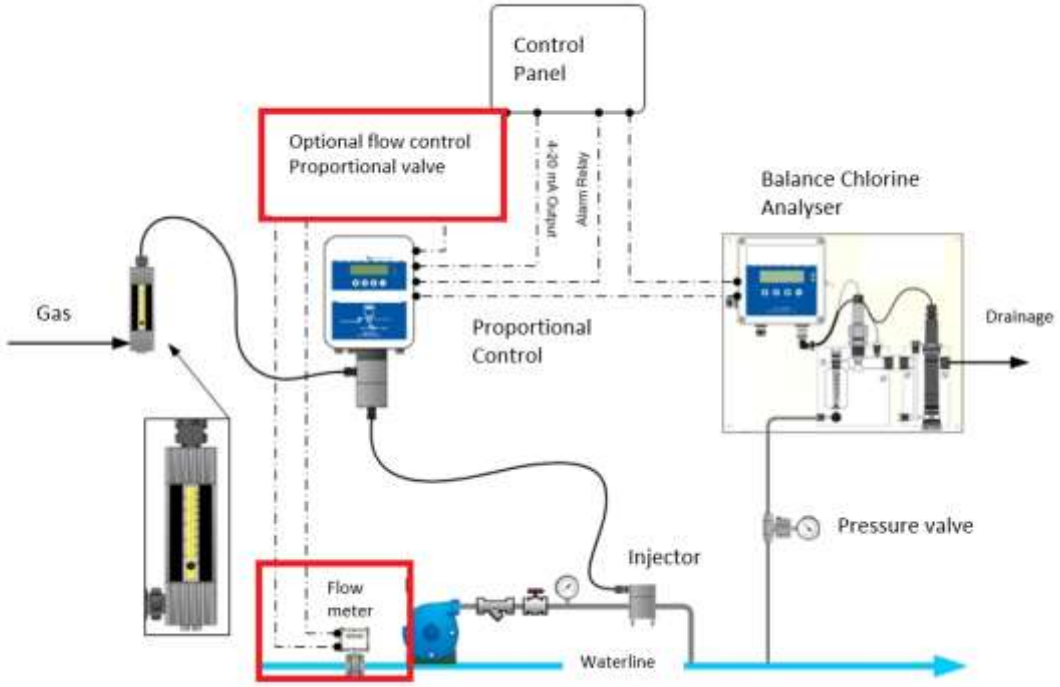


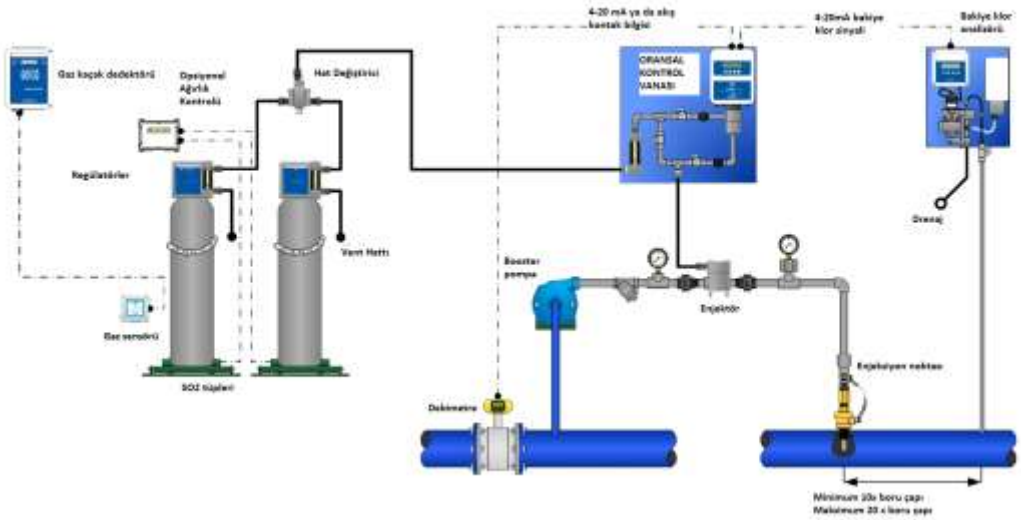
Figure 4. Dechlorization system schematic.

SO_2 is a dangerous chemical, and in situations where there It may create a harmful environment to your health. Breathing before entry into SO_2 equipment and safety equipment must be used.

SO_2 chlorine in the water is removed as follows:

$SO_2 + H_2O \longrightarrow H_2SO_3$
$H_2SO_3 + HOCL \longrightarrow HCL + H_2SO_4$
$H_2SO_3 + H_2O + NH_2Cl \longrightarrow NH_4Cl + H_2SO_4$
$2H_2SO_3 + 2H_2O + NHCl_2 \longrightarrow NH_4Cl + HCl + 2H_2SO_4$
$3H_2SO_3 + 3H_2O + NCl_3 \longrightarrow NH_4Cl + 2HCl + 3H_2SO_4$

The dechlorination system P & ID has been given Figure 5.



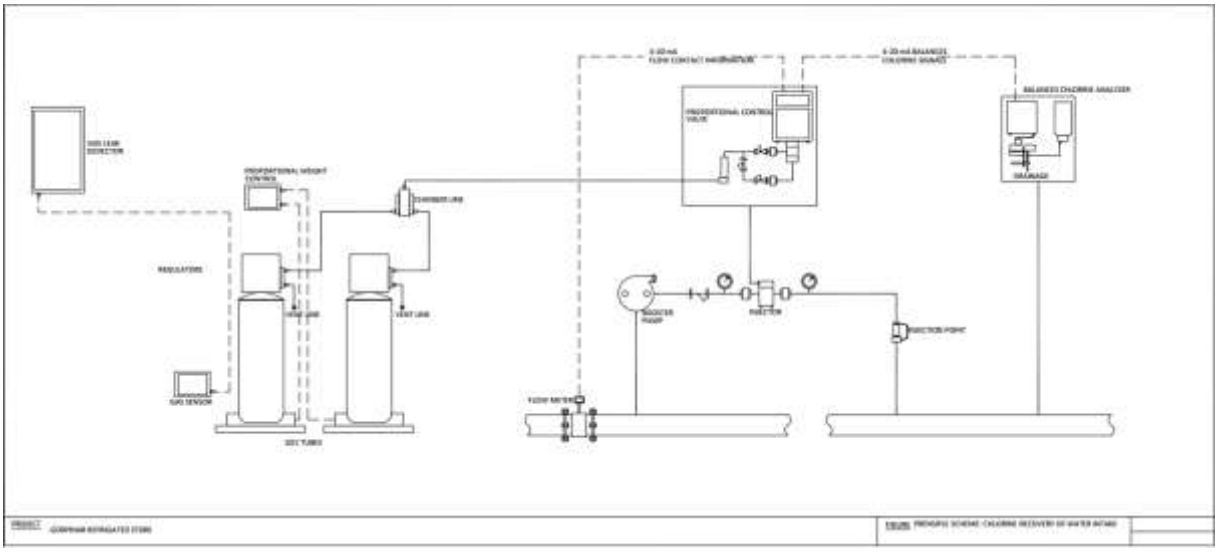


Figure 5. The dechlorination system P & ID

References

AHRAE HVAC Applications, 2007.
ASHRAE Refrigeration Handbook.
GIBSE Guide Environmental Design.
ASHRAE Standard 62.1 - 2007