Application of Integrated Propulsion Systems for Improving the Dynamical Performance of a Frigate

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SUMMARY

The artisanal fishing vessels in our country, currently have cargo holds of fish for storage and transfers from the fishing zone to the landing areas; The same ones during this process do not have adequate conditions of health and care of the quality of the fishing, along with the excess of manual manipulation during the own fishing, stowage, unloading, weighing and stowage inside refrigerated trucks for its transport towards the plants of preserves; which in all the mentioned circuit is observed the little deceleration of the decomposition of the fish, mistreatment and excess of manipulation, excess of procedures that attempt with the control and manual stowage of the load; which causes deficiencies in fish quality and high costs of operation and control during the discharge. In order to solve this problem, a radical change in the processes of storage, transport, stowage, fishing, and control is proposed, through the use of a modular refrigerated system that allows to minimize the times of unloading, manual manipulation and to raise the quality of Conservation of fisheries; the same that can be installed to artisanal fishing vessels in Peru.

INTRODUCTION

Artisanal and small-scale fisheries represent an important impact on the economy and food of our country, since they mainly supply the consumption of hydrobiological resources for Peruvians, and this consumption has been growing in recent years.

On the other hand, artisanal fishing is an area not covered by development of efficient engineering techniques, so there are major deficiencies in the operation and care of fishing.

Therefore, the following will be developed:

- Innovate in the process of storage, transport, stowage and control of the artisanal fishing.
- Container shape design for holds.
- Calculation of the thermal capacity and choice of refrigeration equipment.
- Estimating the structure and simulation of static loads.
- Calculation of the weld for the manufacture of the container.
- Choice of generator set for containers.

PROBLEM

One of the most important deficiencies is that 65% of the vessels store the fish in non-insulated holds, which means that the cargo has direct contact with hot areas, oils and other substances of the vessel; 33% use only ice to delay fishery spoilage and damage; the rest does not use any type of preservation and the hydrobiological resources are arranged among the wineries on the days of fishing.

Another important deficiency is that 80% do not have a sanitary protocol, so when arriving at port the manipulation of the fishing takes place in conditions that put at risk the health of the consumers, as well as the environmental impact of the dirt in the Ports and economic losses when transporting the fishing of the vessel to the transport trucks due to clandestine robberies of the fish, discarding of hydrobiological resources in bad state, and delay in port for times of transfer.

OBJECTIVES

Main Objective

Improve the quality of the hydrobiological resource for human consumption with the innovation of the loading, transportation and unloading process.

Secondary objectives

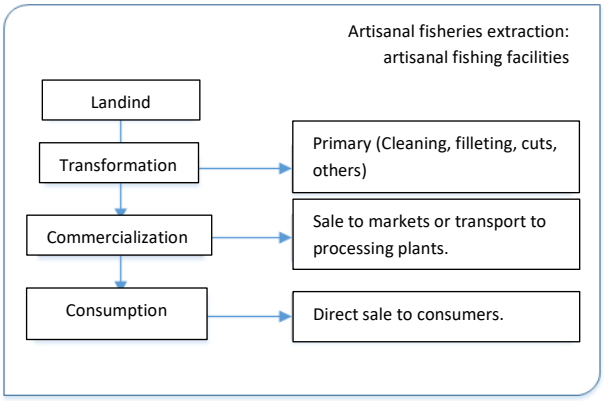
- Minimize labor costs in the weighing and unloading processes.
- Reduce the manipulation of the resource.
- Minimize the time of unloading and thus reduce the cost of rent of the piers.
- Improve ecological, sanitary and health conditions.

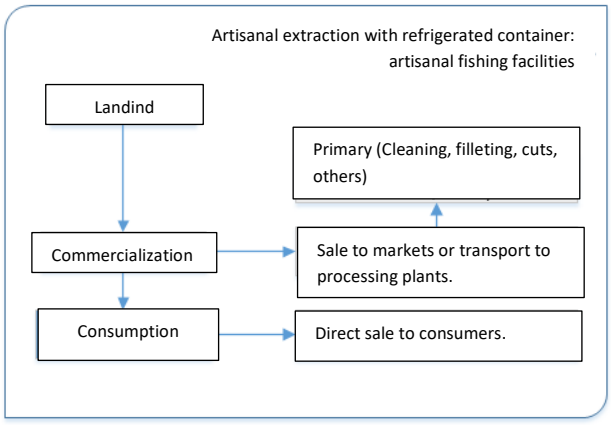
SOLUTION DESCRIPTION

It is proposed to design a refrigerated modular container that can navigate in the hold of the vessel, so that the fishery is stored in that refrigerated container, and when arriving at port the whole module of the container is transferred to the transport trucks, Thus achieving lower port maneuverability, as well as lower environmental impact in ports, reduced handling and direct contamination of fishing, and a better quality of hydrobiological resources for direct human consumption.

The capacity of the container will be 5m3 since the fishing capacities of artisanal vessels are 5, 10, 20 and 30 m3 depending on the dimensions of the ship, so that they can count on 1, 2, 4 or 6 containers to Respectively.

Comparison of fishing extraction processes





Solution development process

a. Main requirements:

Load capacity: 5m3
Dimensions
Width : 1.80m
Height : 1.50m
Length : 4.00m

b. Container shape

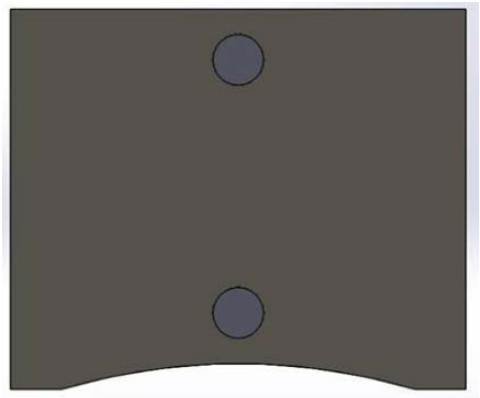


Figure 1: Cross view.

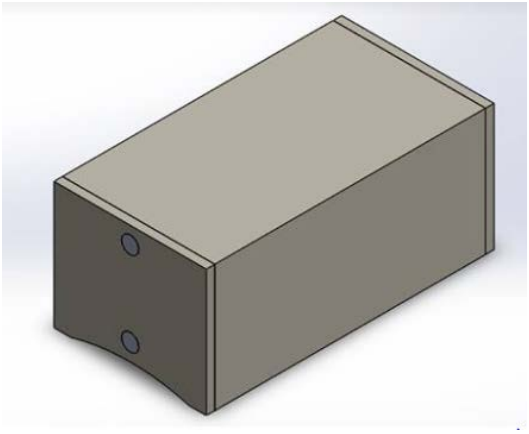


Figure 2: Isometric view.

c. Calculation of termal load

Load for wall losses

Qpa=AxUxTx24 (Kcal/day)

A: área of sides 17.4m2
U: k/e = 0.13
Kpolyurethane=0.013 Kcal/hr-m-°C
e = thickness 10cm
Temperature = T°ext – T°in
T°ext=30°C T°in=-0.5°C (inside)

Qpa = 1651.40 kCal

Door opening load

Qap=VxnxΔhx24 (Kcal/day)

Δh calculation (Difference of enthalpies):

Temperature °C	Relative Humidity 90 %	80 %	70 %	60 %	50 %	40 %
	Enthalpy kcal/m³					
- 45	-16.7	-16.7	-16.7	-16.7	-16.7	-16.7
- 42.5	-15.6	-15.6	-15.6	-15.6	-15.6	-15.6
- 40	-14.5	-14.5	-14.5	-14.5	-14.5	-14.5
- 37.5	-13.4	-13.4	-13.4	-13.4	-13.4	-13.4
- 35	-12.3	-12.3	-12.3	-12.3	-12.4	-12.4
- 32.5	-11.2	-11.2	-11.3	-11.3	-11.4	-11.4
- 30	-10.2	-10.2	-10.3	-10.3	-10.4	-10.4
- 27.5	- 9.2	- 9.2	- 9.3	- 9.3	- 9.4	- 9.4
- 25	- 8.2	- 8.2	- 8.3	- 8.3	- 8.4	- 8.4
- 22.5	- 7.2	- 7.2	- 7.3	- 7.3	- 7.4	- 7.4
- 20	- 6.2	- 6.2	- 6.3	- 6.3	- 6.4	- 6.4
- 17.5	- 5.2	- 5.2	- 5.3	- 5.4	- 5.5	- 5.5
- 15	- 4.2	- 4.2	- 4.3	- 4.4	- 4.5	- 4.6
- 12.5	- 3.1	- 3.2	- 3.3	- 3.4	- 3.5	- 3.7
- 10	- 2.1	- 2.2	- 2.3	- 2.4	- 2.5	- 2.7
- 7.5	- 1.0	- 1.1	- 1.3	- 1.4	- 1.6	- 1.7
- 5	0.2	0.0	- 0.2	- 0.4	- 0.6	- 0.8
- 2.5	1.4	1.2	0.9	0.7	0.4	0.2
0	2.7	2.4	2.1	1.8	1.5	1.2
2.5	4.0	3.6	3.3	2.9	2.6	2.2
5	5.3	4.9	4.5	4.1	3.6	3.2
7.5	6.7	6.3	5.8	5.3	4.7	4.2
10	8.2	7.7	7.1	6.5	5.9	5.3
12.5	9.9	9.2	8.5	7.8	7.1	6.4
15	11.7	10.8	10.0	9.2	8.4	7.6
17.5	13.5	12.5	11.6	10.7	9.8	8.8
20	15.5	14.4	13.4	12.3	11.2	10.1
22.5	17.7	16.5	15.3	14.0	12.7	11.5
25	20.2	18.8	17.3	15.8	14.3	12.9
27.5	22.9	21.2	19.5	17.8	16.1	14.4
30	25.9	23.9	21.9	19.9	18.0	16.0
32.5	29.1	26.8	24.5	22.2	20.0	17.7
35	32.7	30.0	27.5	24.8	22.2	19.6
37.5	36.6	33.5	30.6	27.6	24.5	21.6
40	40.9	37.3	33.9	30.5	27.0	23.7
42.5	45.7	41.5	37.6	33.7	29.8	25.9
45	50.8	46.0	41.6	37.3	32.9	28.4

Exterior:
Relative humidity = 83%
T° = 30°C
hext **=23.9 kCal/m3**

Inside:
Relative humidity = 95%
T° = -0.5°C
hin **=2.42 kCal/m3**

Frequency of opening:

AIR CHANGES IN COLD ROOMS DUE TO OPENING OF DOORS AND INFILTRATIONS

Volume of Room V m³	Air Changes n x/h
6 - 11	1.25
12 - 21	0.85
22 - 34	0.65
35 - 45	0.50
50 - 75	0.45
80 - 95	0.35
100 - 130	0.30
140 - 190	0.25
200 - 290	0.20
300 - 490	0.175
500 - 790	0.125
800 - 1190	0.100
1200 - 1990	0.085
2000 - 4950	0.065
5000 and more	0.045

General formula: $n = \frac{70}{24 \times \sqrt{V}}$,

where n = air changes per hour

V[m³] = volume of room

n=1.25

Qap=4031.36 Kcal

Load per product:

Qpr=(M/t)(CeaDTa+Cl+CedDtd)x24 (Kcal/day)

Cooling time = 2 hr
Density of fish = 1075 kg/m3
Fish mass = 6725.2 kg
Cea (before freezing) = 0.86 kCal/kg°C

Qpr=(M/t)(CeaDTa+Cl+CedDtd)x24 (Kcal/day)

Cooling time	= 2 hr
Density of fish	= 1075 kg/m3
Fish mass	= 6725.2 kg
Cea (before freezing)	= 0.86 kCal/kg°C

Qpr=53498.96 Kcal

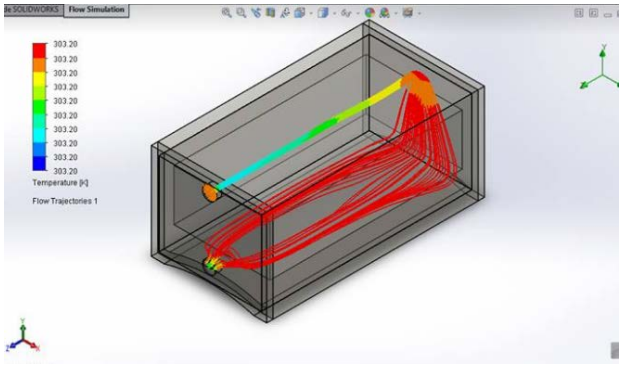
$$Qt = \frac{Qpr+Qap+Qpa}{t} = \frac{59181.74\ Kcal}{18hr} = 3287.87\frac{kCal}{hr}$$

d. Equipment selection

The equipments of a refrigerated container type refeer for the necessary heat flow in the previous calculation have been considered.

The equipment of these refeer occupy a space of 0.4m deep, 1.8m wide and 2.2m high. In our case we will rearrange the equipment in 1m depth, 1.8m wide and 1.5m high.

e. Simulation of heat flow



With the necessary heat flow conditions and load characteristics, we simulate the heat flow in the container in order to evaluate the distribution of heat and temperatures in the load.

We obtained that the temperature did not fall significantly therefore the calculations have been correct.

f. Structure and simulation calculation

Because the structure will be exposed to transfer from the vessel to the truck and vice versa, ie exposed to stresses, as well as conditions in marine environment of corrosion, we chose stainless steel.

Tabla A.1 – Grados recomendados de acero inoxidable para condiciones atmosféricas

Grado de acero según la serie de Normas EN 10088	Tipo de ambiente y categoría de corrosión											
	Rural			Urbano			Industrial			Marino		
	Baja	Media	Alta	Baja	Media	Alta	Baja	Media	Alta	Baja	Media	Alta
1.4003 1.4016	Y[1]	X	X	Y[1]	X	X	X	X	X	X	X	X
1.4301 1.4311 1.4541 1.4318	Y	Y	Y	Y	Y	(Y)	(Y)	(Y)	X	Y	(Y)	X
1.4362 1.4401												
1.4404 1.4406 1.4571	O	O	O	O	Y	Y	Y	Y	(Y)	Y	Y	(Y)
1.4439 1.4462												
1.4529 1.4539	O	O	O	O	O	O	O	O	Y	O	O	Y

Condiciones de corrosión:

Baja: Condiciones de corrosión mínimas para el tipo de ambiente. Por ejemplo casos atenuados por una baja humedad o por bajas temperaturas.

Media: Condiciones consideradas típicas para el tipo de ambiente.

Alta: Corrosión susceptible de ser superior a la típica para el tipo de ambiente, incrementada, por ejemplo, por una humedad alta persistente, temperaturas elevadas, o agentes contaminantes de aire particularmente agresivos.

Clave:

O Potencialmente sobreestimado desde el punto de vista de resistencia a la corrosión.

Y Probablemente la mejor elección entre resistencia a corrosión y coste.

Y[1] Solamente para aplicaciones interiores. Debería evitarse el empleo de aceros inoxidables ferríticos en aplicaciones con acabado superficial.

X Susceptible de sufrir una corrosión excesiva.

(Y) Se puede considerar siempre que se tomen las precauciones adecuadas (es decir, se especifique una superficie relativamente lisa y se realice regularmente un lavado).

Tabla 2.2. Correspondencia entre designaciones de acero inoxidable

EN (10088)	Anglaterra BSI	Estados Unidos AISI	Estados Unidos UNS	Alemania DIN	Suecia SIS	EN (10283)	Francia AFNOR	Composición guia				
								C	Cr	Ni	Mo	Others
1.4005	416S21	416	-	X12CrS13	-	-	Z 11 CF 13					
1.4006	410S21	410	-	X10Cr13	-	-	Z 10 C 13					
1.4016	430S17	430	-	X6Cr17	-	-	Z 8 C 17					
1.4021	420S37	420	-	X20Cr13	-	-	Z 20 C 13					
1.4301	304S31	304	S30400	X5CrNi18-10	2333	1.4308	Z 6 CN 18-09	0.07x	18	8	-	-
1.4303	305S19	305	S30500	X5CrNi18-12	-	-		0.06x	18	11	-	-
1.4305	303S31	303	S30300	X10CrNiS18-9	2346	-	-	0.10x	18	8	-	0.35xS
1.4306	-	304L	-	X2CrNi19-11	2352	-	Z 2 CN 18-10	0.030x	18	10	-	-
1.4307	304S11	304L	S30403	-	2352	-		0.030x	18	8	-	-
1.4310	301S21	301	S30100	X12CrNi17-7	2331	-		.05/.15	17	6	-	-
1.4311	304S61	304LN	S30453	X2CrNiN18-10	2371	1.4309	Z 2 CN 18-10 Az	0.030x	18	9	-	0.22xN
1.4372	-	201	S20100	-	-	-		0.15x	17	4.5	-	6.5Mn
1.4401	316S31	316	S31600	X5CrNiMo17-12-2	2347	-	Z 6 CND 17-11	0.07x	17	11	2	-
1.4404	316S11	316L	S31603	X2CrNiMo17-13-2	2348	1.4408	Z 2 CND 17-12	0.030x	17	11	2	-
1.4406	316S61	316LN	S31653	X2CrNiMoN17-12-2	-	1.4409	Z 2 CND 17-12 Az	0.030x	17	11	2	0.22xN
1.4432	316S13	316L	-	-	2353	-		0.030x	17	11	2.5	-
1.4435	316S13	316L	-	ACrNiMo18-14-3	2353	-	Z 2 CND 17-13	0.030x	17	13	2.5	-
1.4436	316S33	316	-	X5CrNiMo17-13-3	2343	-	-	0.05	17	11	2.5	-
1.4438	317S12	317L	S31703	-	2367	-	-	0.030x	18	13	3	-
1.4439	-	-	-	X2CrNiMoN17-13-5	-	1.4446		0.030x	17	13	4	0.22xN
1.4462	Duplex 2205	-	S31803	X2CrNiMoN22-5-3	-	-	Z 2 CND 22-5 Az	0.030x	22	5	2.5	0.22xN
1.4541	321S31	321	S32100	X6CrNiTi18-10	2337	-	Z 6 CNT 18-10	0.08x	18	9	-	0.5Ti
1.4550	347S31	347	S34700	X6CrNiNb18-10	2338	1.4552		0.08x	18	9	-	0.5Nb
1.4563	-	-	N08078	X1NiCrMoCu31-27-4	2584	-		0.02x	26	30	3.0	1.0Cu
1.4567	304S17	304Cu	S30430	-	-	-		0.04x	18	9	-	4xCu
1.4571	320S31	316Ti	S31635	X6CrNiMoTi17-12-2	2350	1.4581	Z 6 CNDT 17-12	0.08x	17	11	2	0.5Ti
1.4539	904S13	-	N08904	X1CrNiMoCuN25-20-5	2562	1.4584	Z 1 CNDU 25-20	0.020x	19	24	4	1.5Cu
1.4547	-	-	S31254	-	2378	1.4593		0.020x	20	18	6	0.75Cu
1.4529	-	-	N08925	X1NiCrMoCuN25-20-6	-	1.4588		0.020x	19	24	6	1.25Cu

Therefore, we chose 316L stainless steel.

The thickness of the plate will be 6.4mm according to the calculation estimates and simulation results.

g. Calculation of welding

The welding shall be carried out in accordance with EN ISO 15609-1 Specification and qualification of welding procedures for metallic materials. Welding procedure specification Arc welding. And the welders will be qualified according to the EN 287-1 Qualification test of welders. Fusion welding. Steels.

OBSERVATIONS

- 80% of what is produced by artisanal fishing vessels is destined for the direct consumption of Peruvians.
- 65% of these vessels do not have insulated holds reducing the quality of fishing.
- 80% of these vessels do not have health protocols, therefore, they contaminate fishing and docks.
- The energy of the modular containers must be independently of the electrical board of the boat in order not to depend on the maximum demand of the ship.
- It is necessary to make modifications to the ship to implement the modular containers.

CONCLUSIONS

- It is estimated that the time of port delay using the methodology of refrigerated modular containers decreases to 25% in the discharge.
- It is expected that the labor involved in the process of storage, weighing and unloading will be practically nil.
- The stability and structural analysis must be performed due to the modifications and loads added to the boat.
- By improving the quality of conservation and health of the fish, it can be sold at a higher price and the customer will have the option of consuming a healthier product.
- Improvement of environmental conditions in the dock due to the reduction of pollution of the sea waters with fishing waste and other ones of the process of unloading and weighing.

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