Small Vessel Freezing Systems

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Alaska SeaGrant Marine Advisory Program
We’ll cover…

- Flash freezing systems
- Holdkeeping systems,
- Insulation Requirements, and
- Auxiliary Power and Water Needs
Flash freezing...

To effectively freeze seafood you need to freeze it fast...

Slow freezing creates various quality problems

So, just having a freezer hold – no matter how cold – isn’t enough

You need an effective flash freezing system
What are your choices...

For typical Alaska small fishing vessels... like the trollers, gillnetters and shrimpers operating in Southeast...there are basically two choices

- Blast freezing, or
- Single contact plate freezing
Blast freezers

- Blast freezers work by blowing air over the evaporator coils of the freezer unit ... thus removing heat from the air.
- The frigid air blast then circulates around the product... again removing heat.
- The process continues until the desired product temperature is achieved.
Early efforts...

Enterprising fishermen have put together blast freezer systems with used components from freezer trucks and reefer containers.

Many of these systems worked fine...some didn’t. Fortunately, things are a lot easier now...
Purpose built units…

Now fishermen can buy blast freezing units built for marine use, and designed specifically for small vessel operations.

This hatch mounted unit does double duty as an initial flash freezer and holdkeeping system.

photo courtesy of Integrated Marine Systems, Inc
For somewhat larger vessels...

On boats with sufficient deck space, a blast freeze cell can be mounted on deck.

A separate system is installed for the freezer hold.

Typically, the compressors and other refrigeration machinery will be in the engine room.
Blast freezing concerns

Blast freeze systems are simple & reliable, but…

Blast freezing can cause more dehydration loss than other systems. This occurs varies by system and how they are run. Vacuum packing product before freezing obviates this problem.

Blast freezer evaporators tend to get heavily frosted, and require defrost cycles
Plate Freezers

Double contact plate freezers, by well known companies like Sabroe, Kvaerner & Jackstone, are the gold standard for onboard freezing products like boxed prawns, fillet block and such. But, their size, weight, complexity and cost rule them out for small vessel applications.
Single contact plate freezers…

don’t have complex hydraulics and moving plates like double contact systems. They’re not quite as efficient, but are simple, robust & relatively inexpensive.

Common types use extruded aluminum plates that are finned to increase efficiency.
Onboard units...

Racks of freezer plates are often packaged in insulated, self-contained cabinets. They just need cooling water & electricity.

All the refrigeration equipment is conveniently packaged beneath the freezer enclosure.

This 8-shelf unit is for prawns or fillets. Deeper shelf spacing is available for whole salmon.
Small systems...

The full-sized freezer cabinets are too big for deck mounting on many boats. Smaller boat solutions include:

- Hatch mounted units with remote located machinery
- Self-contained chest freezers with integral quick freezing shelves
Hold keeping systems...

The same extruded aluminum plates used in the freezer cabinet can be used in your hold.

Plates are screwed to mounting blocks on the overhead.

Refrigerant is piped thru the bulkhead from the engine room.
Other systems…

Overhead coils – loops of pipe – have been used successfully for years. Finned coils add some efficiency at a cost in upfront cash and durability.

A small blower unit will also work. It’s the same technology as a blast freezer – a fan circulates air over the evaporator and through the hold.
Hold Insulation

Unfortunately, odds are that you don’t have enough insulation. Few boats were built with freezing in mind.

There’s no absolute – but 4” of foam – top, bottom and sides is a decent rule of thumb.

Good insulation assures no “hot spots” and keeps you system from working too hard.
Hold Insulation

Since your hold will probably see double duty in non-freezing applications, probably the best set-up is fiberglass over the foam. It’s durable and easy to clean.

You’ll also need to ensure that there are circulation channels on the side walls and floor.

Building in freezing capability definitely impacts hold volume.
Power & Water

Any serious system will require an AC generator for 110v or 220v power.

Let’s say you have a freezer cabinet with a 10 hp compressor and a hold system with a 7.5 hp compressor.

1 hp = about _ kW, so you’ll need 13+ kW just to run those units simultaneously.
genset sizing...

But you’ll need more than that for start-up – even with “soft start” motors and a generator designed for motor starting.

And you’ll have other demands on your generator. In this situation, a 20 kW genset would probably be quite adequate...But work closely with your refrigeration specialist to carefully assess total demand.
You’ll likely need a seawater system to provide cooling to the refrigeration condenser system.*

Volume demands aren’t huge, but you need a reliable, continuous duty pump…and it’s a good idea to carry a spare.

*Air cooled systems are possible, but have noisy fans and take up a lot of space.
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