



Kodiak Archipelago Leadership Institute
Alaska Ocean Farms and Alaska Sea Grant
Joint Innovation Project:
PILOT SCALE FORCED-AIR DRYING AND MILLING OF
FARMED KELP
SCIENCE OF DRYING
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What Factors Influence Drying?



- Initial Moisture Content
- Layering
- Heat Distribution/Airflow
- Residence Time
- Ambient Air Humidity
- Desired Final Moisture Content

Initial Moisture Content

- Kelp is mostly water 85%-98%, depending on the species. Surface and internal moisture.
- Kelp Evolved to not dry out at low tide
- Pre-drying steps increase drying efficiency but add up-front costs and labor



Layering

- Shredding the kelp helps with this
- Need to keep layers less than ~2" in this dryer
- Needs to be thin enough for heat to penetrate
- Rack system needs to be designed to accommodate this 2" and a layer for optimization of space and drying capacity



Heat Distribution and Airflow

- Is all the product receiving adequate heat?
- Is air moving around the dryer? No “dead” spots?



Residence Time

- How long till all the kelp is <10% moisture?
- At what temp do you dry?
- If continuous, what is the optimal belt speed?



Ambient Air Humidity

- Needs to be relatively low, can't afford to dry air! Optimally less than 50%
- Need a building in AK, temp controlled
- Won't work with high humidity waste heat/air
- Measure with a hygrometer.



How does this fit together?

Drying Rate – By knowing the initial and final moisture content along with the drying time, you can estimate the average drying rate. A faster drying rate suggests better moisture removal efficiency.

Drying Kinetics – You can analyze how different variables (temperature, humidity, material thickness) influenced the drying process. Higher temperatures and lower humidity typically lead to faster drying.

Moisture Diffusion Characteristics – If the material is thick, moisture will diffuse from the interior to the surface before evaporating. You might infer how internal diffusion or surface evaporation controls the drying process.

Equilibrium Moisture Content (EMC) – Based on the ambient humidity and final moisture content, you can estimate whether the material has reached its equilibrium moisture level or if further drying could occur under the same conditions.

Influence of Layer Thickness – If the drying rate was slow, thicker layers could be limiting moisture removal, suggesting potential improvements by using thinner layers.