KAMENGO

"Innovation in On-board Cargo Handling"
2002 Award Winner

Lloyd's List
in cooperation with
SMM

SELF-UNLOADING SHIPS STORAGE AND FEED

Various Vessels and Material Cargoes

SUMMARY

KAMENGO FEEDERS:	(9) 100-foot long Kamengo Feeders
BIN STORAGE:	Total: 40,000 t in all holds
CAPACITY:	3,000 t/hr

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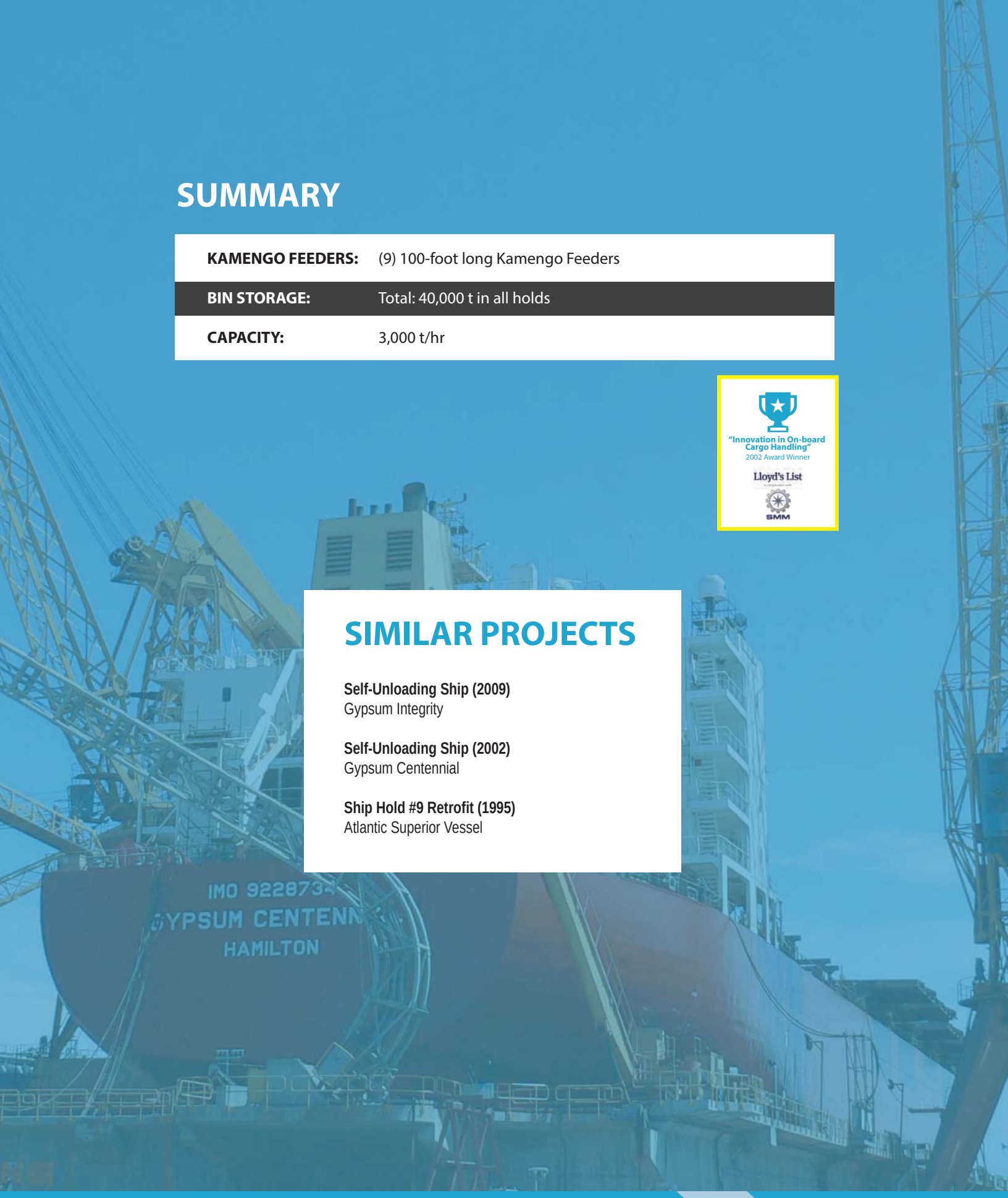
SIMILAR PROJECTS

Self-Unloading Ship (2009)
Gypsum Integrity

Self-Unloading Ship (2002)
Gypsum Centennial

Ship Hold #9 Retrofit (1995)
Atlantic Superior Vessel



SELF-UNLOADING SHIPS STORAGE AND FEED
Various Ships and Material Cargoes

KAMENGO

SYSTEM OVERVIEW

Kamengo Feeders have been in use on self-unloading ships since 1995. The first ship, Gypsum Centennial started up in 2002. US Gypsum subsequently went on to use our technology for the Gypsum Integrity which went into service in July 2009. In 2002, the Kamengo Feeder won a Lloyd's List award for "Innovation in On-board Cargo Handling" based on its successful operation on-board the Gypsum Centennial.

The two GTL ships were designed primarily to handle gypsum from Nova Scotia to USG plants on the US East Coast. Gypsum from Little Narrows, Nova Scotia, tends to be damp and frozen during the spring. Gypsum has been unloaded from the Gypsum Centennial and Gypsum Integrity without the flow problems experienced by their other vessels using conventional technology. On return voyage and during off-season, the ship handles other cargoes. With the slowdown in construction in the US, the two ships have been primarily carrying cargoes other than gypsum. Gypsum Centennial has carried gypsum, coal, iron ore pellets, iron ore fines, granite aggregate, fertilizer, calcite and clinker cement.

The Kamengo Feeder offers several advantages over conventional gate systems:

• The Kamengo Feeder makes it possible for self-unloading ships to carry difficult flowing, sticky and cohesive cargoes. Previously, self-unloading ships were limited to carrying cargoes that could be gravitationally fed using conventional gates.

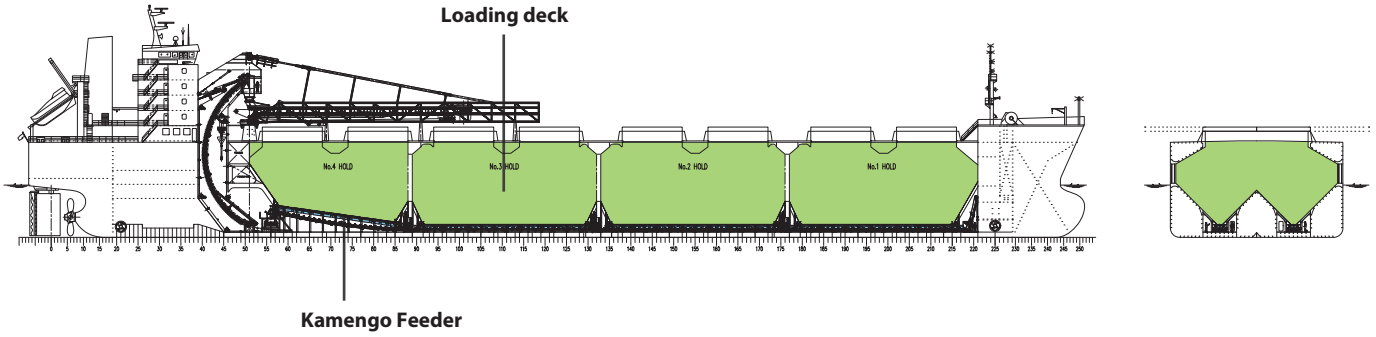
• The Kamengo Feeder does not need hogbacks which are required by conventional gate systems. The absence of hogbacks makes it feasible to reduce the hopper slope by several degrees – significantly increasing cargo volume.

• The Kamengo Feeder's reliable, smooth discharge enables efficient unloading of bulk cargo ships and barges in less time, without the delays associated with cargo "hang-ups".

• A fully automated system frees up crew members for other tasks. Safety concerns associated with clearing up "hang-ups" are eliminated.

• The variable discharge feed rate of the Feeder for any material permits the ship to match the capacity of the shore receiving facility.

SYSTEM LAYOUT



LONG FEEDERS

Long Kamengo Feeders can also be used in land-based configurations:

TALL BINS AND SILOS

Tall bins and silos provide economical storage of a large volume of material with minimum floor space.

Mass flow requires that the hopper walls be sufficiently steep and smooth such that the stored material slides down the sloping walls instead of funneling ("rat-holing") through the center core of the bin.

A first-in-first-out flow pattern results with this hopper design. Structural design of the bin is done using Kamengo's bin wall pressure program, which calculates wall pressures in different areas of the bin.

The bin wall thickness and the sizes and locations of the stiffeners are determined to arrive at an economical design. "Formed" stiffeners instead of standard structural members used typically requires 40% less steel.

LONG BINS

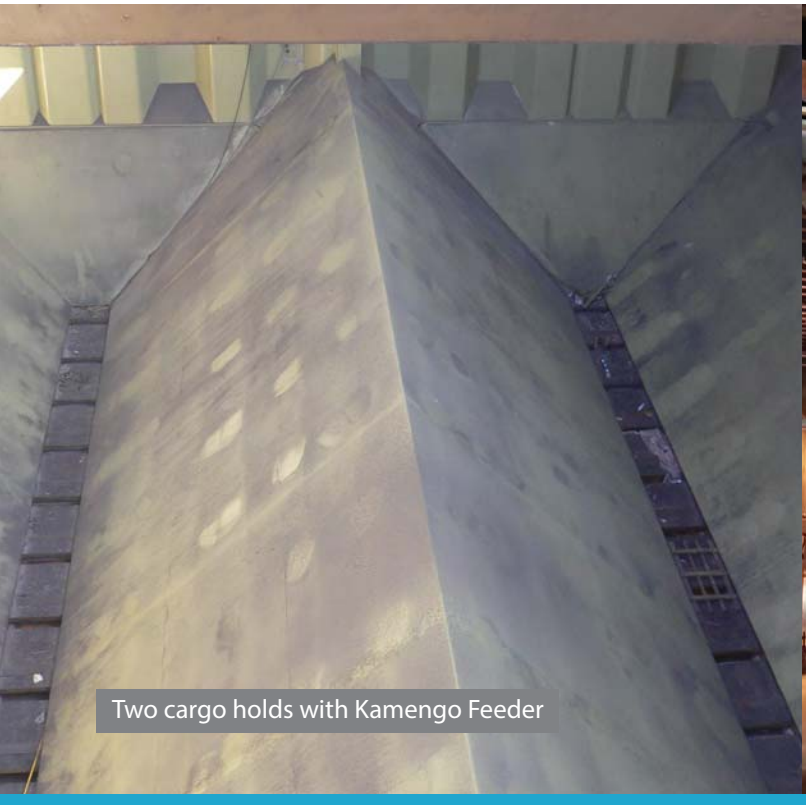
Reclaiming via Long Feeders With the "Moving Hole" feeder system, the hopper and feeder can be made 30 m+ long, and still discharge material effectively and uniformly along the full length. This feature makes our system well suited to reclaiming from under large storage piles, domes and bulk cargo ships and barges.

For domes and ships, "funnel flow" hopper design is used to maximize storage capacity and at the same time, have a self-emptying hopper without manual intervention.

OPEN STORAGE PILES

A long feeder under an open storage pile can provide significant amount of storage. By exceeding the "piping" dimension for the stored material, a shallow "draw-down" angle of material in the pile is obtained.

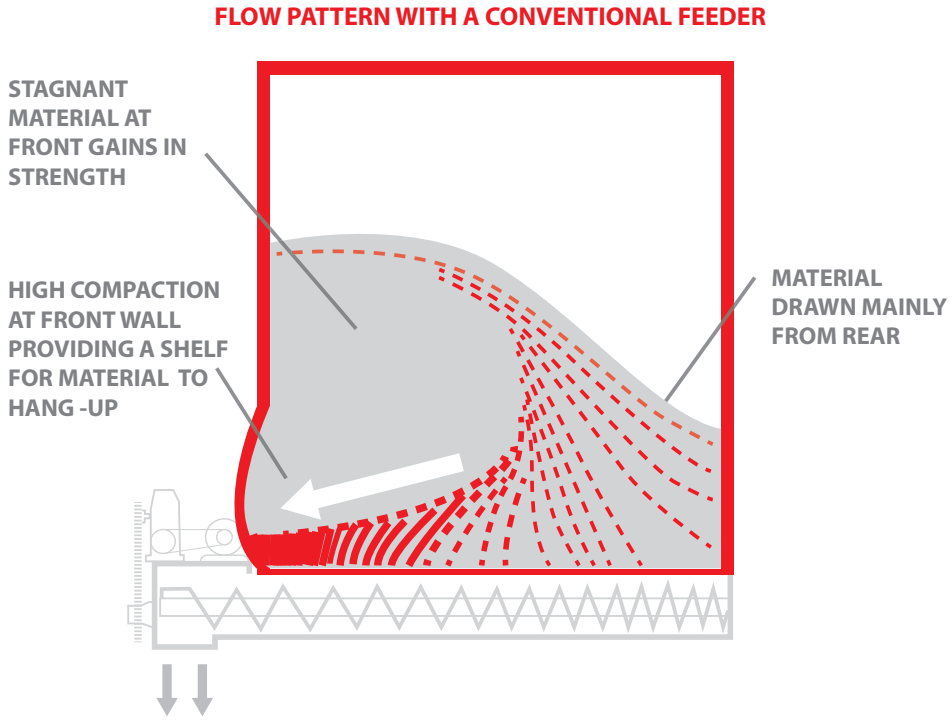
Feeder length of over 30 m (100') can be used for significant amount of "live" storage. Also, several feeders can be installed end to end, as is done on a ship, to cover a long length of pile.



Two cargo holds with Kamengo Feeder

30 Foot long feeder under open pile

WHY DO CONVENTIONAL FEEDERS PLUG?



WHAT IS HAPPENING INSIDE THE BIN?

Most feeders draw material primarily from the rear of the bin, with little material drawn from the front. This problem is particularly severe when handling low bulk density fibrous materials. With fibrous materials, the pulling action of the feeder is felt well above in the bin, resulting in severe compaction, and in extreme cases, distortion of the front bin wall.

POOR FLOW PATTERN RESULTS IN HANG-UPS

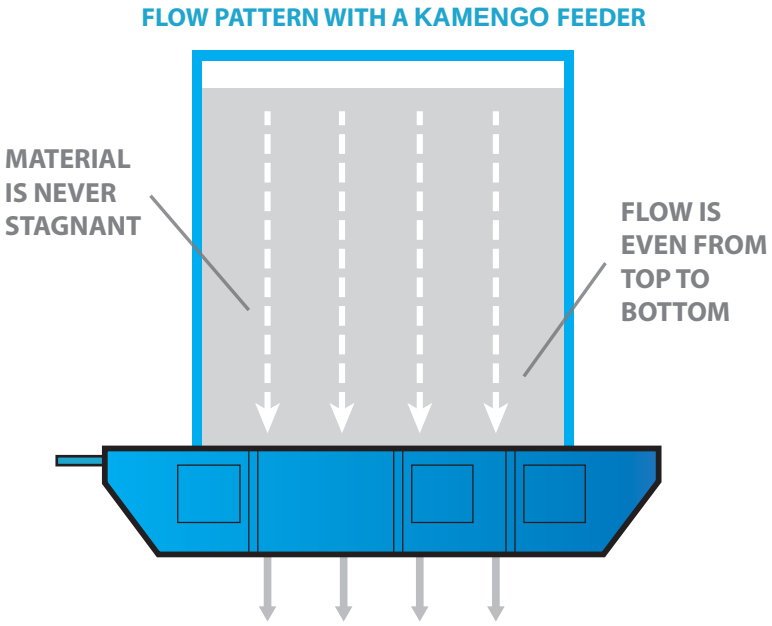
The compacted and stagnant material at the front of the bin is a major cause of bridging and hang-ups. Also, with material drawn mainly from a small section at the rear of the bin, live storage is greatly reduced, and stable rat-holes are permitted to form, resulting in dangerous bin hang-ups.

PUTTING ENERGY TOWARDS THE WRONG PURPOSES

Most feeders withdraw material by developing a shear line at the hopper/feeder interface. This shearing action not only contributes to compaction of the stored material, but also results in excessive wear of mechanical parts.

To learn more about reliable bin and feeder design, visit our website at www.kamengo.com.

HOW IS THE KAMENGO FEEDER DIFFERENT?



The Kamengo Feeder is different because it meters material evenly from the entire hopper outlet. With no stagnant pockets, the stored material is not afforded an opportunity to hang up.

Also, the Kamengo Feeder does not use brute force to extract material out of storage. Instead the Feeder relies on gravity and good bin geometry to reliably discharge the stored material. As such, the Feeder does not compact material, and thus allow it to gain strength and hang up. Also, because the Feeder does not put energy into shearing the material out of the bin, it requires far less power than a conventional feeder, saving energy and minimizing wear.

To learn more about the Kamengo Feeder visit our website at www.kamengo.com.

KEY FEATURES OF THE KAMENGO FEEDER

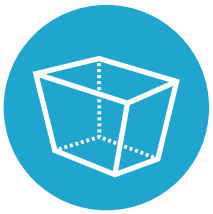
- FEED EVENLY FROM THE ENTIRE OPENING OF BIN
- FIRST-IN, FIRST-OUT FLOW PATTERN
- NO MATERIAL COMPACTION
- CONSISTENT METERING OF MATERIAL
- NO SHEARING OF MATERIAL
- USE GRAVITY TO DISCHARGE
- LOW POWER LOW WEAR
- FLEXIBLE DESIGN

KAMENGO SPECIALIZES IN THE STORAGE AND FEED OF DIFFICULT FLOWING BULK MATERIALS

What makes Kamengo different is the tool kit we use to solve complex materials handling challenges:

Equipment To Characterize The Flow Properties Of Fibrous And Cohesive Materials

In the 1980's Kamengo developed new testing equipment capable of characterizing the flow properties of stringy, fibrous and cohesive materials.

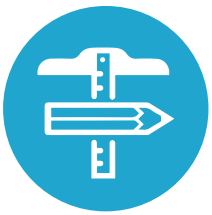


Design Protocols To Determine Correct Bin, Feeder And Chute Geometry

Kamengo has developed design protocols that use a material's flow properties to determine the bin, feeder and chute geometry required to promote reliable material flow. Correct equipment geometry will deny a stored material the conditions it needs to gain in strength and hang-up.

The Kamengo Feeder: Proven Solution For Handling Difficult Flowing Materials

The Kamengo Feeder resolves many of the shortcomings of conventional feeders. The Feeder withdraws material evenly from the full discharge opening of the hopper *and* does not compact stored material, resulting in a fully live bin. With installations running 24/7 for more than 20 years, the Kamengo Feeder has proven that it is a reliable solution for handling difficult flowing materials.



The Kamengo Feeder: A Design Advantage

The flow properties of difficult flowing materials often demand a fully live bin. A fully live bin is very difficult to achieve with a conventional feeder, but is easily achieved with a Kamengo Feeder.

Skilled Design Practice

Over the past 25 years, Kamengo has developed a design practice capable of tackling complex projects, including retrofits of storage and feed arrangements that suffer from plugging. Kamengo has the engineering capability to deliver complete packages of materials handling equipment including storage bins, feeders, chutes, structural work, and conveyors. We have delivered solutions for biomass, ore concentrates, fly and wet bottom ash, wood chips, pellets, and FGD gypsum.

We invite you to explore how Kamengo can apply its specialized tool kit to solve your materials handling challenges.

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