From Powder and Bulk.com

Ask Joe! Column

Belt Conveyor Design For Extreme Cold Climates

Guest article by Paul Janze, Sandwell Engineering

Introduction

Designing belt conveyors for use in extreme cold climates requires special care. For example, temperatures in northern Canada can vary between -45°C in winter to +35°C in summer.

During the winter, snow load, blowing snow and ice build-up are problems encountered. The product being handled can have ice particles frozen to it and can also contain loose snow. And at such extreme temperatures, steel becomes brittle and susceptible to damage from impacts.

In warmer climates, the design limits can be pushed and short, steep, small, high-speed conveyors can be used. In extreme cold climates, simultaneously pushing all design limits is a recipe for disaster; so, it's best to be conservative in your design.

Following is a list of 'do's and don'ts, which I have learned over the years.

Belt Conveyor Do's and Don'ts

1) Snow: You can expect that product stored in open storage piles will be covered with snow for much of the year. The problem can be particularly bad under heavy snowfall conditions where product is allowed to build-up in between multiple snow layers. Unless the snow is scraped off, conveyors should be sized to handle the anticipated amounts of loose snow being reclaimed with the product.

Also, expect frozen lumps to come off the pile. If there is no scalping screen or lump breaker ahead of the conveyor, design your chutes and skirtboards to handle the largest frozen lump. The load on the belt should be kept lower than normal to increase belt-to-product contact and to provide more room for carrying lumps; and the speed should be kept fairly slow. This will result in a wider belt than you might normally select.

2) Belt transfers and angles: Transitioning from one conveyor to another requires special care in order to give the frozen and slippery product time to reaccelerate. To ease the transfer of material from one conveyor to another, limit the conveyor slope in the loading zone to 6°-7°.

Limit the maximum conveyor slope to 12° and avoid across-the-line starting in order to prevent material slide-back when restarting a loaded belt. I prefer electrical soft-starts as they are not affected by temperature and are easily adjustable. Additionally, maintenance can be done in warm electrical rooms as opposed to maintaining a fluid coupling outside in the cold.

If you can't avoid conveyor slopes above 12°, consider using grooved belts (negative cleats), which in my experience are suitable up to 15°. Above 15°, use belts with positive, vulcanized multi-cleats.

Generous vertical concave curve radiuses will prevent the belt from lifting off the idlers and spilling product.

If slide-back is an issue on existing conveyors, you may choose to use de-icing chemicals, which can be sprayed or dripped onto the belt. De-icing systems are costly to install, operate and maintain, and should be installed as a retrofit only if required.

3) Indoors and outdoors: Avoid having a long conveyor which is mostly outdoors, from entering a warm, moist building; otherwise, moisture will condense and freeze on the cold conveyor. It is better to have the transfer occur outside the heated building on to the tail-end of a warm conveyor that is mostly inside the heated building.

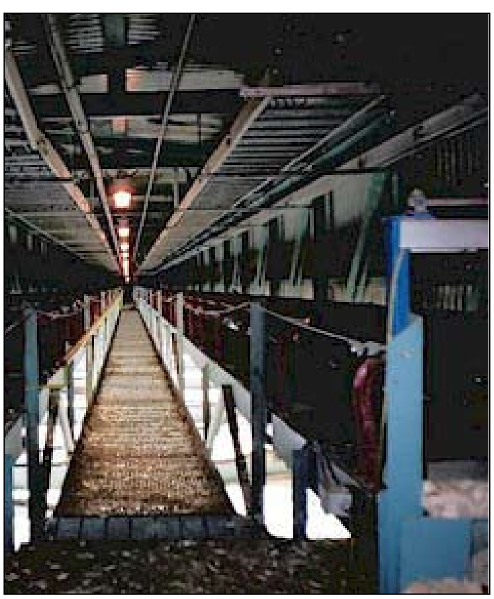
Avoid heating conveyors or transfer towers to the point where the product will thaw out. Not only is heating costly, but there is a danger of the material re-freezing. There is a tendency to apply heat to chutework which is susceptible to freezing. In my experience, this is the worst thing that you can do; all you will succeed in doing is increasing the freezing problem by moving the moisture downstream where it can refreeze.

4) Covers: As a minimum, conveyors should be covered to prevent material blowing off the belt. However, it is recommended that the entire conveyor be carried inside an enclosed gallery with the transfers inside enclosed towers. At extreme cold temperatures, even a slight breeze can cause frostbite to persons in just a few seconds. If working conditions are poor, the equipment may not be properly maintained.

Also, the bottom of the gallery underneath the belt needs to be kept open to permit snow and dust to fall free from the return belt. You don’t want snow and dust to build-up inside the gallery; not only is it hard to remove, but it can result in a serious structural overload condition. The amount of snow and dust falling off return idlers can be substantial, so provide lots of space under conveyors for clean-up access.

5) Personnel access: Access on frozen, snow covered surfaces can be treacherous. Use stairs and avoid ladders wherever possible. Use safety-grip grating on walkways and platforms. Northern areas have very short days, so provide good lighting along conveyors.

Experience has shown that the worst seasons for conveying are the Spring and Fall `shoulder’ seasons, where temperatures are +/-5° C and freeze / thaw / refreeze conditions can exist daily.



6) Conveyor components: Extraordinary expansion and contraction can be expected with extreme temperature ranges and must be accommodated in the design of conveyors and structures. For example, a 500 ft conveyor will expand and contract approximately 5.5" with a temperature range of -45° to +35°C. The conveyor and structures must have a sufficient quantity of expansion joints, properly placed to accommodate this expansion and contraction.

Use belting designed for extreme low temperatures; those which retain their flexibility without cracking.

Use lubricants designed for extreme temperature variations. Under extreme cold temperatures, the viscosity should not increase to the point that grease and oils solidify; they must remain fluid. Conversely at extreme warm temperatures, the lubricants should not thin-out to the point where they are no longer lubricating.

Use drive pulleys with large diameters and vulcanized diamond-shaped lagging. The use of snub pulleys is recommended. Avoid high alloy steel pulley shafts. It's best to stay with large diameter, low carbon shafts. Use thick pulley end discs, which resist flexing.

Space pre-tensioned safety pullcord switches closer together than is normal to minimize the effect of pullcord contraction / expansion causing nuisance trips.

If the conveyor system utilizes belt weigh scales, plan on recalibrating them at least twice yearly; once in the winter and again in the summer.

7) Belt cleaners: Avoid using belt brush cleaners; they will immediately fill up with snow and dust and be ineffective. Two sets of carbide-tipped belt scrapers are recommended for scraping frozen snow and dust off the belt. There will be a lot of snow dust coming off the scrapers, so provide lots of room underneath the scrapers inside the head chute.

Raised-cleat belts are hard to clean; belt scrapers cannot be used. The only effective way to clean them is to use a properly designed and applied air-knife. Also, you may want to consider a `thumper' roll to shake the frozen snow and dust off the return belt.

Snow and dust will stick to almost any surface; therefore, use large chutes with steep angles and large radius corners between chute plates. If possible, line chute plates with UHMW PE or PTFE plastic, to which ice and snow don't readily stick.

8) Dust control: If dust control is part of the conveyor system, recognize that the amount of airborne `dust' to be handled will be many times greater in the winter; snow crystals will be loosened from the product and sucked into the dust pick-ups. Baghouses can quickly become clogged with packed snow. So, it is recommended that high efficiency cyclones, which are less prone to plugging, be used.

9) Fire protection: If fire protection is required, you must take special care with the design. Dry systems are required to prevent lines from freezing. Keep the size of sprinkler zones small, so that if one is activated you don't have a huge area to drain before it can freeze. Heat or flame detection is recommended.

Biomass: Wood chips and others

Most of my experience has been with biomass conveyors, primarily woody biomass in all its myriad forms. However, I believe that many of the recommendations apply to the conveying of other materials in extreme cold climates.

Biomass is particularly hard to handle; it is inherently wet and therefore freezes. The particle size is rarely uniform. Biomass tends to 'knit' together and generally doesn't flow well, particularly when packed with snow. So depending upon the actual material being handled, avoid converging chutes wherever possible.

Frozen wood chips are brittle and readily break up on impact into smaller particles, which is a concern for certain processes; so limiting product speed is important.

Biomass can contain contaminants, which may normally be removed by screening; however, in winter dirt and grit can freeze and stick to the wood chip particles. Special cleaning systems may be required.

Biomass material density can vary widely depending upon the form of the biomass and the moisture content. Determine the amount of 'bone dry' fiber needed for the process; then use the lowest density for volumetric capacity calculations. You may want to consider allowing extra capacity for the handling of excess volumes of loose snow. For power and strength calculations, use the selected volume but at the highest density.

In Conclusion

I realize that not all of the above recommendations can always be accommodated, particularly those to do with conveyor geometry. For example, sometimes you have no option but to use conveyors steeper than recommended above. Also, budget concerns can exert pressure on design features such as using open galleries or minimizing length, which has the disadvantage of increasing slope, or running conveyors faster to minimize the size.

I also acknowledge that many existing installations are not constructed as I have described and yet work satisfactorily. Every installation is unique and all conditions must be considered; but if you have the space available and budget accordingly, and if you follow the above guidelines you can construct an effective, problem-free cold weather conveying system.

About our author

Paul Janze is a senior material handling specialist with more than 30 years experience in engineering, equipment design and manufacture, project management and plant maintenance, primarily in the forest products industry. He is a specialist with difficult-to-handle materials such as wood chips, hog fuel, wastewood and bark, biosolids sludge and wet pulp, poultry litter and boiler ash which all have differing and unique handling characteristics.

For more information contact:

Mr. Paul Janze
Material Handling Specialist
Sandwell Engineering Inc.
885 Dunsmuir Street, Suite 600
Vancouver, BC, V6C-1N5
Canada
Telephone: 604-684-9311
Fax: 604-688-5913
Email: pjanze@sandwell.com
Web site: http://www.sandwell.com/

++++++++++++++++++++++++

Welcome to Ask Joe!, a monthly column by our resident materials handling guru, Joe Marinelli of Solids Handling Technologies. Joe addresses the issues that bug you the most. And Joe knows!! Formerly with Jenike & Johanson, Solids Flow and Peabody TecTank, Joe is an expert on materials handling.

For past articles, **Ask Joe!** Archived Articles.

Guest articles for the **Ask Joe!** Column are always welcome, for more information please contact Joe Marinelli directly at his email address: joe@solidshandlingtech.com.