NEW ECOLOGICAL MATERIAL FOR THE WINTER TREATMENT

Joseph Mucaria
Public works, La Chaux-de-Fonds, Switzerland
joseph.mucaria@ne.ch

RESUME

Public works of the City of La Chaux-de-Fonds, in Switzerland, developed an ecological material, intended mainly for the winter treatment of the pedestrian surfaces (sidewalks, trails, public places…). It can also be used on circulated roads, with light traffic (entries of garage, residential zones…).

This product is non-skid, which makes pedestrian trails and surfaces safe. The intention is to offer an alternative to the use of salt and fine mineral gravel, for the treatment of snow-covered or icy surfaces.

The product is made of wood chips, 5 to 20 mm long and few millimeters thick. These chips are impregnated of a brine (normally containing Magnesium chloride), and then dried before conditioning. However, the water content of the conditioned product is over 40%, which confers a fast reactivity in contact with the snow-covered or icy pavement, in order to ensure fast incrustation.

The product, which is internationally patented, offers the following significant advantages:

- Long-lasting action, in absence of snow precipitations: even during few precipitations, treated wood chips dissolve snow, above them. Thanks to its low apparent bulk density, wood chips tend to stay on the surface.
- Comfort and safety: the shape of the chips ensures an excellent stability and adherence to the pedestrian. The salt, impregnated in the chips, makes it possible those to be encrusted in snow or ice. Thus, they do not roll nor slip under the feet (or wheels of vehicles).
- Easy use: Chips can be spread with traditional mechanical means (gravel or salt spreaders). The material is easy to handle, while light.
- Small environmental impact: the product does not generate dust during spreading. It is biodegradable. The brine used for chips impregnation, usually magnesium chloride, has a neutral pH. It is thus little corrosive. As the content of salt in the chips is low, volume of the rejections in nature is low too. Sweeping of the chips projected in gardens, flower beds or road shoulders, under the action of the snowploughs or the snow-blowers, is not required.
- Respectful of our domestic animals: the shape of the chips (flat), the nature of the material (wood) and the small percentage of salt, do not wound the legs of the domestic animals.

KEY WORDS

Winter maintenance, trails, sidewalks, ecological, adherence, chips, wood, brine.

1. INTRODUCTION

In Switzerland, conventional maintenance of sidewalks and other pedestrian trails covered with a layer of hard snow, ice or glaze consists with spreading of fine gravel and/or salt - in general sodium chloride.

This treatment calls upon relatively cheap materials, however, their effectiveness lasts only little time and the treatment must consequently be frequently renewed. Daily in usual.

In the long term, the quantities used are thus important.

Salt is not toxic for the environment. Nevertheless, the use of large quantities can bring to significant modifications of the salt content of the ground water. A reduction of the salt content, when this is noted, proves to be difficult and long.

With regard to the fine gravel, this material, once swept, must either be washed in order to remove their impurities - organic elements in particular, before being able to be re-used, or run to spoil in special bioactive pits. As there are few of tem, storage is expensive consequently.

In order to solve these problems, the authors designed and developed a product made up of wood chips impregnated of brine for the treatment of sidewalks and other snow-covered or icy pedestrian trails.

2. COMPOSITION

The product is composed of flat parallelepiped wood chips. Chips are max. 20 mm large, and few mm thick.

This form was selected due to the following advantages:

- Large specific surface. It thus makes it possible to ensure a good cover of the icy surface with little matter.
- Large surface contact. This characteristic ensures the pedestrian an excellent adherence.
- Low twinge. This property ensures a good stability to the pedestrian by preventing that the material does not roll under its feet, as that can be the case with mineral fine gravel.

Photo 1 - Treated wood chips on snow-covered surface

Wood is generally tender (spruce, poplar, birch, etc). The tender wood chip has indeed a better behavior and holds under the action of heavy loads like wheels of vehicles.

The salt used for the impregnation of the chips is one following:

- Sodium chloride
- Magnesium chloride
- Calcium chloride

or a mixture of those.

Magnesium chloride is usually selected due to its neutral pH, and consequently its small corrosive impact on metallic structures.

The water content of the chips is adjusted close or over 40%. Salt in the chips is then immediately reactive and dissolves the ice or snow, thus allowing chips incrustation.

3. USE - IMPLEMENTATION

Wood chips are used mainly for the treatment of snow-covered or icy sidewalks and trails. It can also be used on low traffic roads exclusively used by light vehicles.

Requested dosage is approximately 150 g/m^2, that is to say 15 to 20 chips under a footprint (photo). This quantity offers an excellent adherence and ensures the pedestrian a higher safety, or at least equal to that offered by gravel.

Photo 2 - Surface aspect with a correct proportion of chips

Spreading is done as for gravel or salt:

- By hand
- With traditional spreaders. Some equipment requires small adjustment of the system before use. Tests were carried out with various equipments for their homologation.

Photo 3 - Hand spreading

Photo 4 - Mechanical spreading

4. ENVIRONMENTAL IMPACT - HEAVY METALS

The treated wood chips are often spread on sidewalks, close to roads. Therefore, question was to assess whether wood could absorb part of heavy metal generated by the traffic or not, and in the affirmative, in which proportion. The answer is indeed essential for the re-use the material at the end of the winter, by composting in particular.

The study that was carried out consisted in taking samples of chips in some places of the downtown area at the end of the winter and in measuring the quantity of heavy metal in the chips. For comparison, we also determined the content of heavy metal on unused samples of treated wood chips. The analysis method that was selected entitles mineralization of dried and crushed chips in a microwave oven in the presence of nitric acid. This method is defined in the federal ordinance on the reduction of the risks related to the chemicals (ORRChim) [1].

Mercury content was not analyzed, due to the difficulty of extraction, but also to its volatility, and because the interest of its determination was not considered to be relevant by the chemist. We also did not analyze the content of HAP and dioxins, as the ordinance gives only indicative limit values.

The results are shown in the following table:

	1	2	3	4	5	6	
Sample	CPX-Calcium 09-0973	CPX-Sodium 09-0974	ABM 09-0975	Kaufmann 09-0976	P. L.-Robert 09-0977	Migros Centre 09-0978	Limit values ORRChim
Zinc [g/to dry]	5.92	7.90	38.05	38.70	95.89	57.37	400
Copper [g/to dry]	2.40	1.82	13.56	8.32	15.85	12.93	100
Nickel [g/to dry]	0.80	0.79	0.79	0.80	2.40	1.60	30
Lead [g/to sec]	6.39	3.96	18.13	24.00	103.80	30.69	120
Cadmium [g/to dry]	0.69	0.50	1.06	0.80	1.45	0.37	1

Tableau 1 - Content of heavy metal in treated wood chips

For treated wood chips, that were not used (columns 1 and 2), the content of heavy metal comes from wood, but also from the impurities of salt used.

The results on the chips collected at the end of the winter in various places of the downtown area (columns 3, 4, 5 and 6) are largely lower than the applicable limit values (green colored cells), except for the Cadmium content in samples 09.0975 and 09.0977 (in orange).

The higher content of Zinc, Copper and Lead in the collected chips (by comparison with the treated chips, not used) remains still below limit values. The most significant increase relates to Lead.

We note thus that, as opposed to our fear, treated wood chips spread on sidewalks in side of roads do not act like traps with heavy metals.

Wood chips should thus be able to be re-used by composting at the end of the winter, in so far as the contents of inert undesirable substances are respected [1]. Following inert substances are undesirable:

- Synthetic metal, glass, matters coarse,
- Synthetic sheets, pieces of plastic, bags, strings,

By mixing the chips collected at the end of the winter season with organic waste gathered during the summer period (grass in particular), this makes it possible to improve the carbon/nitrogen ratio of the compost.

5. ELIMINATION - VALORIZATION

Classical treatment with mineral fine gravel on snow-covered or icy surfaces during the winter, requests, at the end of the season, removal of the gravel in a bioactive pit, because of its content of organic elements or washing before re-use.

These two solutions are expensive. Moreover, the first one offers a poor ecological assessment, due generally to the long haul to deliver material in a bioactive pit on one hand, and by the non-valorization of the fine gravel on the other hand.

6. ADVANTAGES - INCONVENIENCES

The main advantages of the treated wood chips are:

- Their shape
- The matter
- The impregnation with salt

The shape of the chips, rectangular and few mm thick prevents those from rolling, in contrary to mineral gravel. It thus offers a better stability and consequently a better safety to the pedestrian.

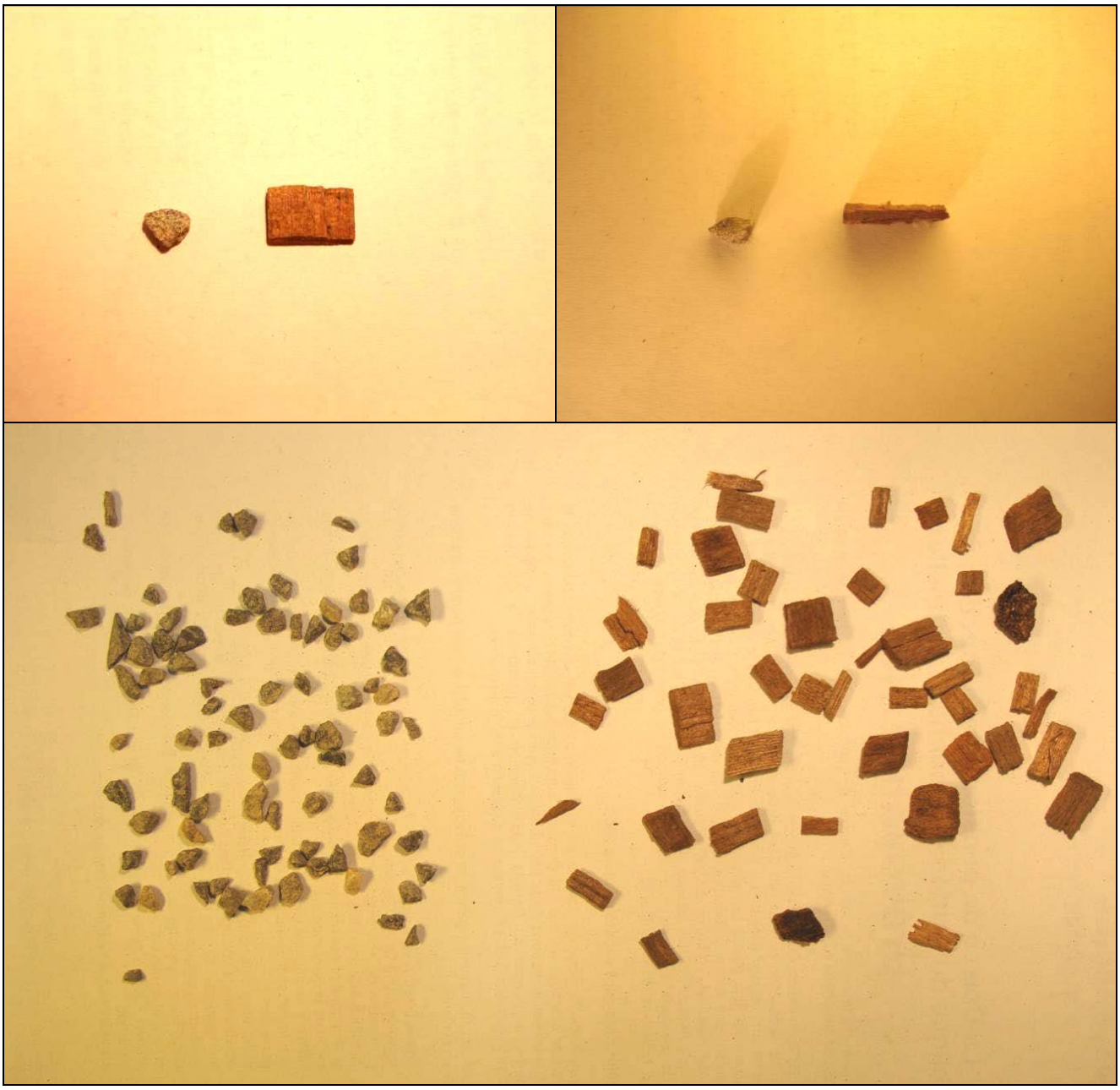

Photo 5 – Comparison of L has form between treated wood chips and fine gravels mineral

The stuff of the chip, out of wood, offers a better comfort than mineral gravel. The pedestrian has the feeling to walk on a carpet. This feeling strengthens the sense of security already improved by the shape of the wood chips. Wood also offers the benefit of being biodegradable. When projected on the sides, or evacuated naturally or by washing in the clear water supply network, wood chips will be eliminated naturally in the biotope at the end of their race. When brushed, wood chips can be composted, preferably by mixing it with green waste (grass for example), in order to facilitate the process of degradation. They can be also eliminated by combustion, while producing of heat or electric power. Weightless, the material is consequently easy to handle.

The melting impregnated in the wood chips dissolves the ice or snow when in contact with the face of the chip. This one thus starts to penetrate in its support. However, due to the apparent bulk density, the movement slows down and then stops. The chip freezes in its support, before having disappeared from its surface. This is not the case with mineral fine gravels, which tend to disappear in the support sometimes a few hours after their application, if the temperature is relatively lenient. Thus, without new precipitation of snow, it is not necessary to renew the spreading of wood chips during several days. Magnesium chloride, which is usually used, has a neutral pH, which avoids or limits rot appearance.

The melting in the chips acts during several days. It prevents or limits the formation of ice on clear for snow, but wet surfaces. In the event of light precipitations of snow, salt melts the snow, which covers chips.

The other advantages of the treated wood chips are as follows:

- The abundance of the raw material.
- Its low content of salt
- Its size

In countries, which significant winter conditions (presence, even profusion of snow and ice), wood is generally abundant. That is not always the case of the rock allowing the production of fine gravel. Wood chips can thus be locally produced and used, which reduces transport and thus supports the ecological report of material.

Chips are slightly impregnated with salt (approximately 3% mass). Dissemination of melting in nature is thus limited. Salt is not strictly speaking pollutant; nevertheless it can have an impact on the groundwater. This may happen with the use of the classical techniques of salt or brine spraying.

Size of the wood chips is similar to that of the mineral gravel. Therefore, traditional spreading devices can be used for wood chips without or with minor modification. Thus, there is no particular investment for the use of the treated wood chips for winter treatment.

The principal inconvenience of the product is its price.

In Switzerland at least, the cubic meter of wood is more expensive than that of the mineral gravel. And as the impregnated wood chips are a worked out material, it is significantly more expensive than the standard products used for winter, namely salt and mineral gravel.

However, when correctly used, the treated wood chips can be cheaper in final. Indeed, when the chips are spread on a snow-covered or icy support, and with forecasts of good weather conditions (cold, but no snow precipitation) over several days, there is no need of further treatment. That is not the case with traditional treatments with fine gravel and salt. In this case, it is necessary to renew the treatment at least once per day. In final, as well material consumption, as the time devoted to the spreading operations, and consequently the final cost appear greater than with the treated wood chips.

7. CONCLUSIONS

The wood chips impregnated with salt represent an interesting alternative to the standard techniques of treatment of snow-covered or icy sidewalks, trails, and other pedestrian surfaces.

They make it possible to use an abundant and renewable resource in areas where winters are rough.

Composed essentially of organic substance, wood, they can be re-used at the end of the winter, by manufacture of compost or by production of energy, for example.

Their use is simple, as the shape and size of the chips was studied to allow the use of conventional spreading machines.

Treated wood chips are comfortable and safe for the pedestrian and do not wound legs of domestic animals.

With a low content of salt, wood chips thus avoid any risk of accumulation of salt in ground water.

Used in a judicious way, the treated wood chips prove to be economically interesting.

REFFERENCES

[1] ORRChim, 18 mai 2005, Ordonnance sur la réduction des risques liés aux produits chimiques, annexe 2.6 "Engrais"