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Impact of Heat Shield Thickness on Performance of Roll through Simulation

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Abstract: ***Rolls of the packing machine undertakes an imperative job in packing industries. So as to decrease the power input and reducingthe heat dissipation rate, there are numerous methodologies, for example, surface coatings, surface boronizing and with heat shields and so forth. This work is expected to reducethe power contribution to heaters by diminishing the heat dissemination rate utilizing heat shields with simulation of different thicknesses. There is a decrease of dissipation of heat by using Stainless steel 316 Ti (0.7 mm thickness) heat shields and there is a reduction of 13.9% in power input, 28% time saving and14% in heat dissipation rate is noticedwhencompared to standard rolls up to steady surface temperature where there is saving of 198W per hour in power after steady temperature. Hence an attempt is being made for improving results that are obtained from experiments by using simulation through ANSYS steady state thermal analysis. From the results it is inferred that as thickness of heat shield increases the input electrical energy for the heater goes on reducing and results shows that 0.7 mm thickness shield is 4.28% efficient than 0.8 mm heat shield. Further through simulation optimum thickness is was observed. But thickness is restricted to 1mm only because of machine specification complexity. Further the results of simulation for varying thickness are presented with contours of temperature distribution and heat flux.***

Keywords: Roll, Heat Shield, Heaters and Shield thickness, Simulation

I. INTRODUCTION

Building steels have shifted to yield for the necessary properties from ENIA (230M07) – EN41 (905M39) i.e., EN1A, EN3B, EN8, EN16, EN19, EN24, EN32, EN36, EN40B, EN41. Moves of pressing machine are produced with En8 steel which have better properties contrasted with gentle steel. Surface preparing assumes huge job to have diminished warm conductivity so as to have low warmth move from the outside of the moves thusly low warmth scattering.

By fire and enlistment solidifying process, EN8 steel is heat treated to give great surface hardness and moderate wear opposition and with the information on cutting exchange among misshapening and grain microstructure size.

exposed to arranged working conditions [1]-[2]. It was contemplated that the surface boronizing by means of sand impacting will diminish thermal conductivity due to decreased grain size and expanded the volume division of balance grain limits [3]. Rather than metals, for the most part Earthenware production are progressively impervious to oxidation, consumption and wear, just as being better warm encasings, these are generally utilized for warm obstruction coatings like YSZ, PSZ and so on [4]. It was discovered that for fluid Nano artistic coatings will make minuscule cell earthenware microspheres which diminishes the warm conductivity is around 0,001-0,003 W/mK in view of development of vacuum-empty balls on high temperature dissolved fired [5]. Warmth shields shield structures from extraordinary temperatures and warm slopes by two essential instruments, for example, warm protection and radiative cooling. These are moderately separate the basic structure from high outside surface temperature while emanating heat outwards through warm radiation. For heat shield applications, low warm conductivity materials are basic and tempered steel 316Ti can be picked for examination based its creation and properties for the reasonableness of warmth shield [6]-[7]. TIG welding method is good as for procedure and furthermore to hold the shield quality for securing of the warmth shield in the ideal state of the move [8]-[9]. By embeddings the hardened steel in high temperature liquid Li2BeF4 (FLiBe) salt, it was accounted for that the erosion obstruction for the treated steel will be more [10]. Further it was closed with investigates treated steel to contemplate the impact of oxidation in very basic water and announced that the tempered steel is less defenseless to oxidation [11]. Specialist's investigations expounded the strategies for surface alloying and surface covering to the treated steel to expand the wear opposition and to diminish the general warm conductivity [12]-[13].

From the above talks warms shields are most surrendering and conservative to build the presentation of rolls. Hardened steel 316Ti is chosen as warmth protecting material in light of progressive properties, for example, low warm conductivity, high protection from consumption and pitting at high temperatures than other regular chromium-nickel austenitic treated steels. Warmth shield, tempered steel 316Ti are manufactured in the structure as shallow surface of rolls and cladded them to moves as obstruction fit

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II. METHODOLOGY AND SIMULATION

A. Methodology

Simulation is done for the rolls with heat shields taking material properties as stainless steel 316Ti for heat shield and En8 for rolls. Comparison of results is done in simulation by varying the thickness of the shield starting from the 0.5 mm and results are evaluated for the maximum temperature at the cutting edge of the roll.

B. Simulation

In order to evaluate the impact of heat shields for one of a kind material and variant of any operating/design parameters rather of wasting the material and lead time fabrication on strive is being done the use of simulation techniques. Simulation is executed for the rolls with variation in thickness of shields with ANSYS steady state thermal analysis with applicable boundary prerequisites ascertained from the experiments. The images of mannequin of rolls with varying thickness of heat shields for experimental heat input are shown in figure 2(a) -2(d).

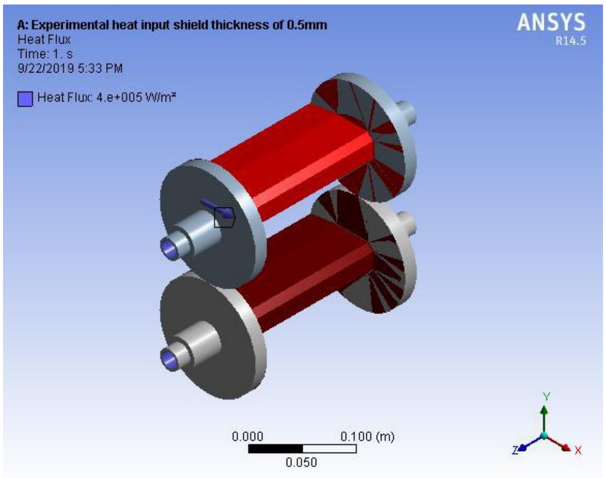


Fig 2(a) 0.5 mm thickness shielded roll

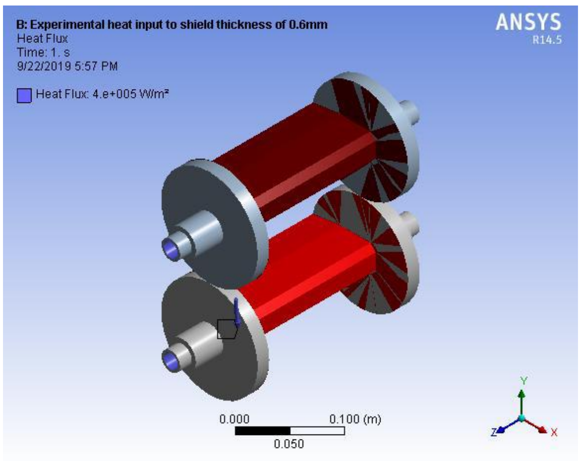


Fig 2(b) 0.6 mm thickness shielded roll

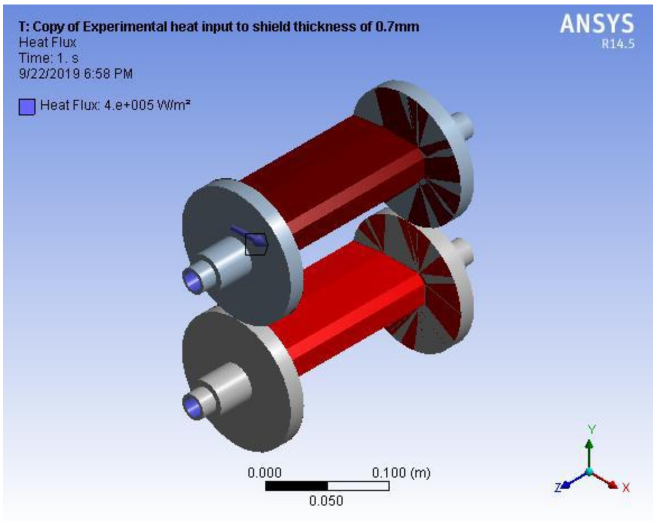


Fig 2(c) 0.7 mm thickness shielded roll

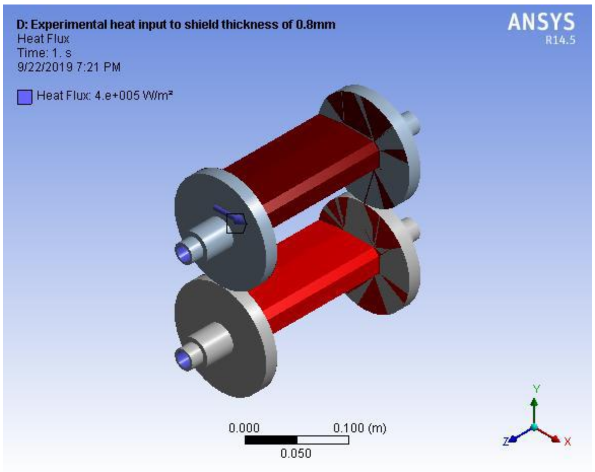
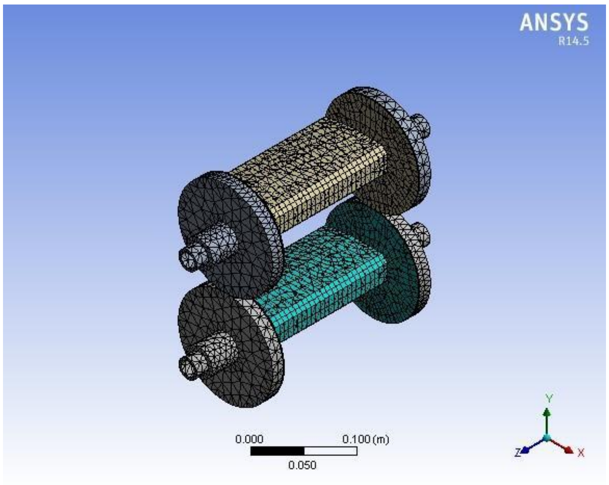


Fig 2(d) 0.8 mm thickness shielded roll

For the standard roll heat shields have to be incorporate, so for that it is essential to find at what thickness of heat shield the results are getting effectively and efficiently for the rolls. In simulation it is compared that at what thickness of the heat shield for the constant experimental heat input maximum temperature is attaining.so as to reduce the complexity of the fabrication of the heat shield in reality this procedure is followed.

Meshing

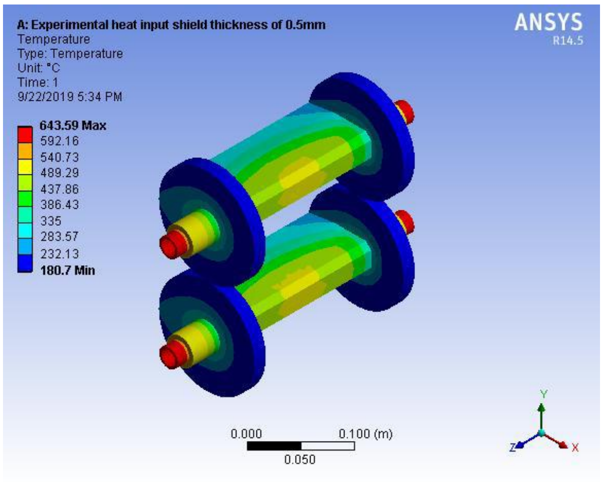
Meshing is the instrument utilized in the product configuration to partition the whole segments into a limited number of little components as required. The greatness of the split parts must be as modest as essential, with the goal that the full number of split segments must be as large as fundamental, making the discoveries exact. Lattice for the roll is finished by making 32001 hubs and 18579 components for the exact assessment of results and cross section is shown in the fig 2(a).



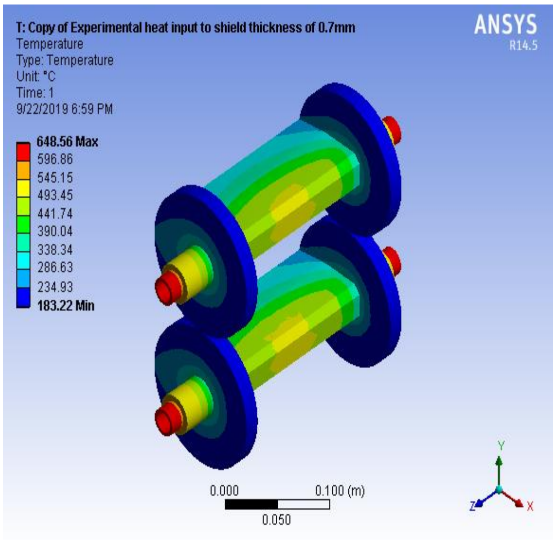
2(a) Meshing of Roll

III. RESULTS AND DISCUSSIONS

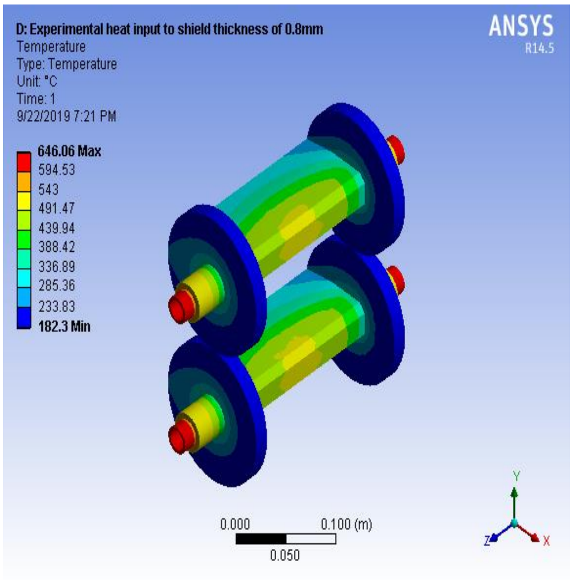
A. Temperature contours for the experimental heat input in simulation to attain 175^{0}C.



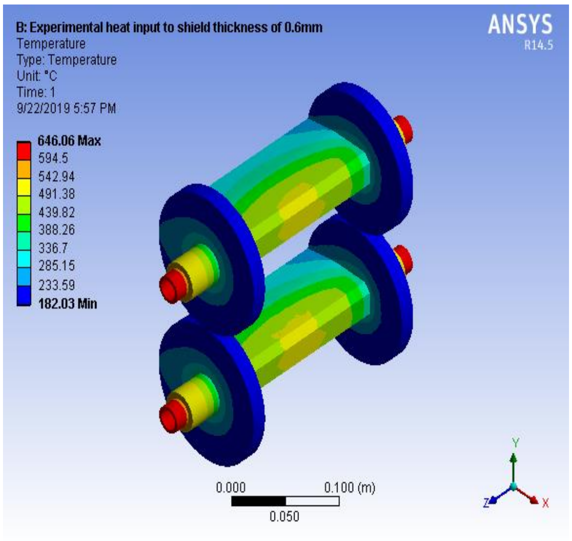
3.1(a) Temperature contour for experimental heat input 0.5 mm Thickness Shield



3.1(b) Temperature contour for Experimental heat input 0.6 mm Thickness Shield



3.1(c) Temperature contour for experimental heat input 0.7 mm Thickness Shield



3.1(d) Temperature contour for experimental heat input 0.8 mm Thickness Shield

Fig 3.1(a) to 3.1(d) shows how the temperature is varying as the thickness of the heat shield is increasing from 0.5 mm to 0.8mm. The temperature on the roll at the cutting edge is increasing as the thickness is increasing for the given constant heat input (i.e., 400kj).from 0.5 mm to 0.7 mm thickness temperature is increasing (i.e., 180.70C to 183.22^{0}C) and beyond 0.7 mm thickness the temperature at the cutting edge is decreased (i.e., 183.220C to 182.3^{0}C).so at the thickness of 0.7 mm of the shield maximum temperature is attained. So for experimental heat input in simulation temperature are going beyond 175^0 C to get a temperature of 175^{0}C heat input have to be decreased for different thickness of the shields.

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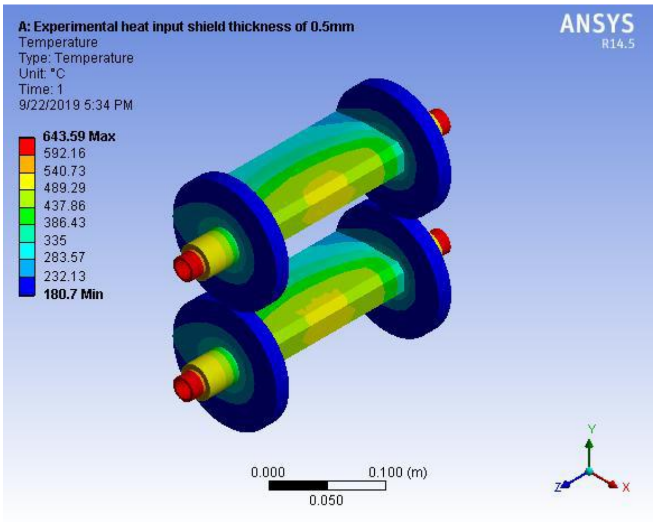
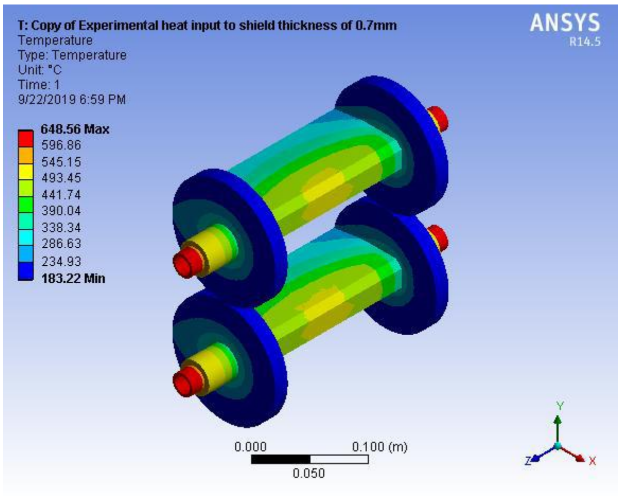
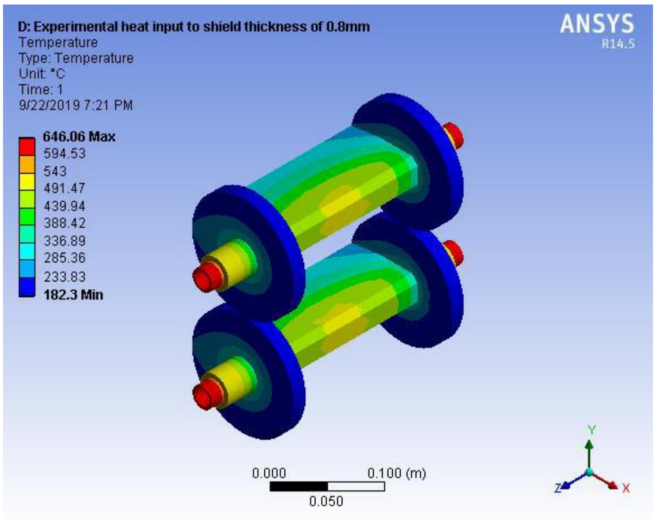
B. Temperature contours for the simulation heat input in simulation to attain 175^{0}C



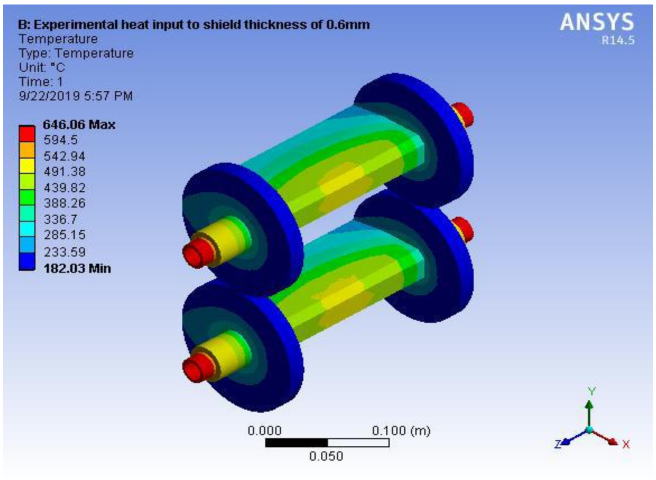
3.2(a) Simulation Heat input 0.5 mm Thickness



3.2(b) Simulation Heat input 0.6 mm Thickness



3.2(c) Simulation Heat input 0.7 mm Thickness



3.2(d) Simulation Heat input 0.8 mm Thickness

Table 3.2 Variation in Temperature for Experimental Heat Input and Simulation Heat Input

Shield Thickness in mm	Heat Input Experimental in simulation	Simulation heat input to attain 175^{0}C	Temperature attained for Experimental heat input	Temperature attained for Simulation heat input
0.5mm	400Kj	385Kj	180.7^{0}C	175.24^{0}C
0.6mm	400Kj	382Kj	182.03^{0}C	175.41^{0}C
0.7mm	400Kj	376.5Kj	183.22^{0}C	175.17^{0}C
0.8mm	400Kj	380.5Kj	182.3^{0}C	175.12^{0}C

Fig 3.2(a) to 3.2(d) shows the temperature contours of the shielded rolls in simulation for the simulation heat input to attain 175^{0}C for different thicknesses. In this as thickness of shield is increasing reduction of heat is also increasing up to 0.7 mm thickness and beyond 0.7mm thickness reduction of heat is decreased with respect to the experimental heat input as shown in the table3.2

Table 3.2 Shows as the shield thickness is increasing the for a constant experimental heat input temperature is also increasing up to 0.7 mm thickness of the shield as the thickness is increased beyond 0.7 mm temperature at the cutting edge of the roll falls and for the simulation heat inputs same variation follows but with the decreased heat inputs in comparison with simulation heat inputs. Simulation heat input is also decreased up to the 0.7 mm thickness and beyond that simulation heat input also increasing. By considering these two factors in to effect a heat shield thickness of 0.7 mm gives effective results and beyond this results are in contrast.

Fig3.2 (e) shows how the temperature is varying at the cutting edge of the rolls with respect to the thickness of the heat shields. It shows up to 0.7 mm thickness temperature increases and beyond this temperature decreases. Fig3.2 (f) shows how simulation heat input is decreasing up to 0.7 mm thickness of the shields and beyond this thickness simulation heat input is increasing with respect to the experimental heat input.

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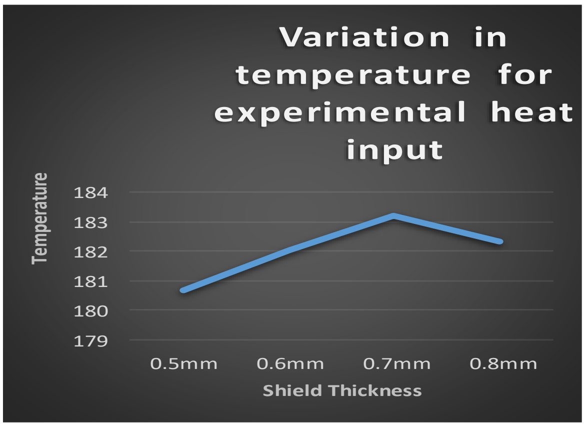

Fig 3.2(e) Temperature vs Shield thickness

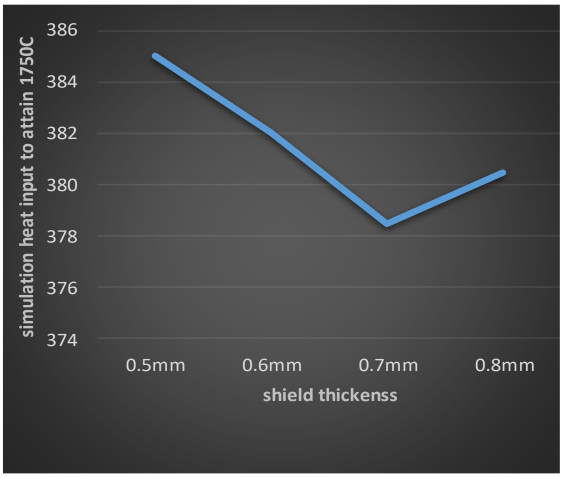

Fig 3.2(f) Simulation Temperature Vs Shield Thickness

IV CONCLUSIONS:

- Through simulation it is concluded that a shield thickness of 0.7 mm gives optimum results beyond this thickness results are in contrast.
- At 0.7 mm thickness shield maximum reduction of simulation heat input is possible to attain 175^{0}C and that is 6.125% less in comparison to experimental heat input.
- For 0.7 mm thickness shield there is saving of 18.2kj of energy in comparison to experimental heat input.
- 0.7 mm shielded roll gives best results out of all thicknesses of the shielded rolls in comparison to standard rolls

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