Rocky Forge News

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Next Rocky Meeting: 1/9/2016

Happy New Year everyone. Hard to believe its here, but here it is, and I trust we can do even better this year than last.

Happy Bicentennial Indiana!!! We have a lot to plan for this 200th anniversary. One of the highlights of the year will be the annual "History Day" for the 4th graders from the surrounding counties. At that event the Bicentennial torch will pass through the show grounds. As I keep reminding you, we need to focus on blacksmithing as it was in the 1816 period.

To help us do that Melvin Lytton will be at our next meeting Saturday to demonstrate a very useful "double cusp Suffolk latch" (a.k.a., bean latch). Those were used extensively in the 1800's log cabins, and Melvin made many of them while at Conner Prairie.

We will have coffee and doughnuts ready by 8:30 with the demo starting around 9:15.

Bring a covered for lunch dish that we can pass. **Bring food!!!** Also, don't forget ***Iron-in-the Hat*** items. See you all on Saturday, January 9th.

Ted Stout

Blacksmith Auction

Tri-County Auctions, Arcola, Illinois will have an all blacksmith auction January 22 at 5:00 P.M., Indiana time. He is currently accumulating items for the sale and is taking consignments at this time. There will be over 40 anvils, forges, swage blocks, top and bottom tools, hand tools and many miscellaneous blacksmithing items. Last year there were several IBA members present and it was a very good auction.

For more details go on AuctionZip.com and put in the upper right hand box of the page Vern Yoder's auction zip identification, which is "14498". By doing this you can view photos of his auction and watch it grow over the next two weeks. It is an Amish auction with some pretty good food. Last year it was over by 9:00 P.M.

Ted

John Bennett discusses making a Christmas bell at the IBA meeting on December 12 at Don Reitzel's shop. That's Gene in the background.

John's forged snail.

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The Physics of Anvils

text & illustrations by Eric Chang, Sunnyvale

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At first glance, the primary system that the blacksmith uses to shape metal – the hammer and the anvil – seem to be simple, not demanding of deep analysis. The anvil is an immovable, non-deformable object upon which the hammer squashes the target with the force/energy of its blow. If it is necessary to do more work or larger jobs, just use a bigger hammer and/or swing it faster.

But, should the anvil be correspondingly larger? That seems to make sense, since the anvil could no longer be considered immovable when hit with a larger hammer. Not only might the anvil no longer be immovable, but it might be damaged.

Which is more efficient?

How much more efficient?

How big is efficient or efficient enough? Do other factors – anvil shape or mounting, for example – influence the process in important ways? Our experience tells us that such factors are important. In this article, we will examine the physics of the hammer/anvil interaction to produce both qualitative and quantitative insights. For example, what hammer/anvil mass ratio is necessary to obtain 95% forging efficiency?

This article is the first in a series that will examine the physics of the forging process, working from simple, rough analyses upward to more complex and detailed analyses.

As blacksmiths, we are all familiar with the feeling of striking hot steel: that satisfying feeling of the hammer transferring it's energy into heating and deformation of the hot steel. For this initial analysis, that *satisfying feeling* corresponds to what physicists call an *inelastic collision.*

In an inelastic collision between the hammer and the anvil, momentum is conserved:

Initial Momentum = Final Momentum

Expressed mathematically,

$$[m_a v_a + m_h v_h]_{initial} = [m_a v_a + m_h v_h]_{final}$$

m_a = mass of the anvil
v_a = velocity of the anvil
m_h = mass of the hammer
v_h = velocity of the hammer

Physics of Anvils

For this analysis, consider the inelastic case in which the hammer is moving along with the anvil after the collision. That is, the hammer sticks to the target. This is like all of the energy in the hammer being deposited into the target and the anvil – that is, all of the hammer energy goes into squishing the target and moving the anvil. All movement after the collision – movement of the hammer + target + anvil together – represents energy which is not used for forging.

Efficiency is the energy deposited (lost) into the target. The fractional efficiency is written as:

$\varepsilon = (E_i - E_f)/E_i$

$E_i = 1/2\,[m_a v_a^2 + m_h v_h^2]_{initial}$

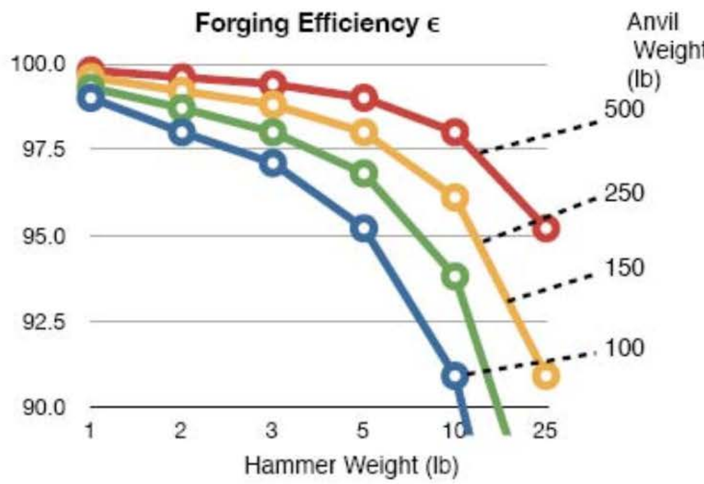
$E_f = 1/2\,[m_a v_a^2 + m_h v_h^2]_{final}$

E_i = Initial energy
E_f = Final energy

Calculating the kinetic energy yields the following equation for ε (skipping lots of mathematical equations beloved by physicists and engineers):

$\varepsilon = m_a / (m_a + m_h)$

This equation is plotted here.



What does this imply for the blacksmith?
Several points come to mind:

1. Good forging efficiency (as measured by energy transfer) demands that the hammer/anvil mass ratio be kept low.
2. If you go to a bigger hammer, get a larger anvil or tie the anvil solidly into the earth.
3. Forging efficiency is *not* a function of how fast you swing.

There you have it. Tell your partner that for good forging efficiency you just gotta buy a bigger anvil.

A more detailed analysis is posted on the CBA website. ♣

Eric Chang holds a PhD in Chemical Engineering and now works in scientific computing. He has been blacksmithing for seven years, including being the resident smith at Hidden Villa Environmental Education Program and working as a demonstrator at the Wawona smithy in Yosemite.

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