Optimum Speed

Some observations on Low Load Operations from a Charterer’s perspective.

Jonathan Young
Cargill International SA
24th October 2012
TYPICAL TC VESSEL DESCRIPTION

description: bulk carrier, engines, bridge and accommodation aft strengthened for heavy cargos - holds 2, 4, 6 and 8, may be empty.

- speed / consumption basis good weather conditions of up to beaufort force 4 and douglas sea state 3 and no negative influence by swell/ adverse currents:
  - laden: about 14 knots on about 66.3 m.t. ifo 380 cst
  - ballast: about 15 knots on about 66.3 m.t. ifo 380 cst
- fuel specifications:
  Ifo: rmg 380 iso 8217/2005
  Mgo: dma iso 8217/2005
- port consumption: idle about 3.0 m.t. ifo 380 cst + about 1.0 mt if boiler required for heating of fuel oil
- all dets about

Charterers option to slowsteam the vessel down to 60 pct mcr subj to master's approval which not to be unreasonably withheld.

Eco speed/consumption for chrts guidance only and wog: abt 13.5 knot b on abt 45 mts / abt 12.0 kts l on abt 45 mts
Questions:

1. What is the Optimum Speed for the vessel for each sea passage?
2. What additional data do we need in order to instruct the Master?
3. How do we monitor the situation during the sea passage?
4. How do we evaluate our decision(s) at the end of the sea passage?
Optimum Speed?

This is the speed at which the total costs of the voyage are minimised.

Costs (for Charterers):

Hire Paid
Bunkers Consumed
Speed – vs – Consumption

We know the consumption at 14 knots is warranted at 66.3 mt.
We have an indication (wog) that the consumption at 12 knots will be 45mt.

If both these points are accurate, which speed will produce lower costs?

Obviously we cannot calculate this without:
1. Hire Rate – lets assume $10,000 per day
2. IFO Price – lets assume $650 per mt

Lets also assume a Laden passage of 5000 miles in good weather and the vessel has a clean hull!!
Voyage Costs (Laden)

A. Normal Service Speed (14 knots)

\[
\text{Hire cost} = \text{time taken} \times \text{hire rate} = \frac{5000}{14} \times \frac{10000}{24} = \$148,809 \\
\text{Fuel cost} = \text{time taken} \times \text{daily consumption} \times \text{fuel price} = \$641,294 \\
\text{Total Cost} = \$790,103
\]

B. Owners “Eco” Speed (12 knots)

\[
\text{Hire cost} = \$173,611 \\
\text{Fuel cost} = \$507,812 \\
\text{Total cost} = \$681,423
\]

So by proceeding at “Eco” speed we should save $108,680
But is this (12 knots) the Optimum Speed?

Would we have lower total costs by going slower or faster?
Theory

According to basic principles of ship propulsion a vessel should obey the following law known as the propeller law:

\[ \text{Consumption (Power)} = a + b \times \text{speed}^3 \]

Where \( a \) and \( b \) are constants.
So we have the following (theoretical) relationship between Vessel Speed and Consumption:
And if we apply this principle to total voyage costs we get the following:

This suggests an optimum speed of just below 7 knots.
BUT – if we have a different combination of hire rates and bunker prices (eg $30,000 and 450) we get a different curve:

This suggests an optimum speed of around 11 knots
AND – if we have a further combination of hire rates and bunker prices (eg $40,000 and 350) we get another different curve:

Which now suggests an optimum speed of the CP speed -14 knots
So – The Optimum Speed?

Is variable depending on the hire rate and fuel price and therefore the CP “Eco” speed is not likely to be “Optimum” in all cases.

Also we observe very different results for different types of vessel (generally, smaller vessels have higher Optimum speeds, other parameters being equal).

But – What flexibility do we have to proceed at different speed as a time-charterer (or indeed as an Owner).

And – To what extent will the vessel (at sea in all weather conditions) perform according to the theory?
Speed Flexibility.

Generally limited to the upside by MCR (generally not possible to proceed at more than 85\% MCR for long periods)

Limited on the downside for “normal” slow steaming by the point at which the “Auxiliary Blowers” cut in – ie if you go lower than this, the engine requires an auxiliary blower to be operated which has technical problems. This is very ship specific but most vessels in the bulk fleet would be limited to a minimum of somewhere between 45\% and 55\% of MCR.

For Ultra-Slow Steaming its getting much more technical and unless a vessel has more than one turbocharger fitted, requires supply of an additional Auxiliary Blower to be carried on board as a spare.

In practical terms, for an average Bulk Carrier (with a normal service speed of 14.0 knots laden) normal slow steaming would correspond to a minimum (good weather) speed of about 11.5 to 12.5 knots.

[so in today’s market the Owners “Eco” terms might actually turn out to be Optimal!!]
NOW – The $64,000 question – How do vessels actually perform at sea?

Do they follow the propeller law or not?
Example 1:

Panamax vessel with hire rate $15,000 and HFO price $650 – cp speed 13.7 – min speed 12.5

Result: by slowing down from 13.7 knots to 12.5 knots the voyage costs **INCREASE**
Example 2:
Handy vessel with hire rate $15,000 and HFO price $650 – cp speed 14.0 – min speed 11.5

In this example slow steaming actually saves almost $39,000
Questions

Why do some vessels obey the propeller law quite closely whereas some apparently don’t follow it at all?

What about the effects of weather – bearing in mind that on average for most trans-ocean passages, the weather is “good” for less than 50 pct of the time?
Answers

Why do some vessels obey the propeller law quite closely whereas some apparently don’t follow it at all?

We wish we knew!!

What about the effects of weather – bearing in mind that on average for most trans-ocean passages, the weather is “good” for less than 50 pct of the time?

Hopefully WNI can tell us more about this!!
Thank You for Listening

Please feel free to ask any questions!