

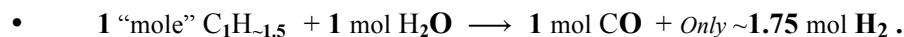
On Page 3 of this presentation, their jingle, 'One proven technology, two line-ups' – well, there is far more than two line-ups. There are *far* more than just **two** *Process Trains*, where each *Process Train* is a complex series of chemical *Unit Operations*, in which the output of one *Unit Op* is fed into a *subsequent* *Unit Op*, with this happening repeated times in different equipment and conditions *each* time!

For example – just to make methanol – the hydrogen to carbon monoxide ratio, the “**H<sub>2</sub>/CO** ratio” [whose pronunc. is defined *shortly*] has to exceed **2.0** by *several percent*.

But when one gasifies coal to make Syngas & related gasses, one gets an **H<sub>2</sub>/CO** ratio that is far-*less* than the *required* Ratio of H<sub>2</sub>/CO [rêishyo âv H-tû-cí-Ôu], with brackets indicating how it is *said*): an *H<sub>2</sub>/CO* ratio of more than likely **2.1** will be an *imperative* for making Methanol.

But the typical Coal is unearthed as a hodge-podge of Hydrocarbons whose ~polymeric structures have an empirical “Bulk-solid” formula anywhere between C<sub>1</sub>H<sub>-1.5</sub> to as low as C<sub>1</sub>H<sub>-0.5</sub>. This is because coal has a lot of aromatic content typically even poorer in **H** than is *Benzene* – C<sub>6</sub>H<sub>6</sub> – which has an H/C ratio of solely “**1**”.

But even the “**H-richest**” of Coals can't –without *Additional pricey* process trains– generate Syngas whose “**H<sub>2</sub>/CO** ratio” is anywhere Near the ~2.1 required for Methanol. With the Best **H-richest bituminous** Coal for the *said* **Shell Syngas Reactor** running above 1600°C with reactive *Steam* in its “Core”:



The above Syngas with the **1.75 H<sub>2</sub>/CO** ratio that leaves the Shell-reactor that had been fed the *most-Favorable* Coal still possesses *nowhere Near* the ~**2.1** ratio required for Methanol.

### Problems in making Ammonia with Syngas from Coal

The first two *major* Problems in making **NH<sub>3</sub>** using *Coal* syngas are the following:

1. The *intrinsically-Low* H<sub>2</sub>/CO ratios<sup>‡</sup> of such a *gaseous Cocktail* created from **Coal** (whose H/C ratios are “*intrinsically low*”) ‡[H-tû-cí-Ôu” rêishyoz];
2. The Fact that *three moles* of Hydrogen are required to react with just *one mole* of Nitrogen to make Ammonia:



The above relationship where *three* molecules must find & react with one makes for complex, *Multi-collision reactions* that require **Lots** of surface area loaded with Poison-prone *Solid* catalysts !

### NH<sub>3</sub> Problem #3: High-purity reactants

The entering H<sub>2</sub>/N<sub>2</sub> reactants cannot contain more than *Trace*-amounts of Carbon and/or Oxygen compounds, otherwise the catalysts for forming **NH<sub>3</sub>** can & **will** become “poisoned”.

### NH<sub>3</sub> Problem #4: an Unstable Molecule

while *Economically acceptable* formation rates require that the reaction be run at ~500°C, the *Ammonia Process Train* has got to *Quick-quench* the resultant **hot** ammonia to 200°C or less, along with *all* the unreacted H<sub>2</sub> & N<sub>2</sub> (which molecules comprise >>50 vol.%, *thus* making this Mix of gasses *difficult* to cool w/O high CAPEX equipment!).

The complexities *above* are due to the fact that thē **NH<sub>3</sub>** molecule is *not* very thermally stable: the *thermodynamic* “driving force” for the formation of **NH<sub>3</sub>** is far-*weaker* than that of **CH<sub>4</sub>** (*Méthane*).

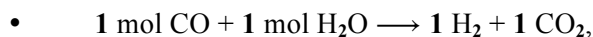
Ammonia's fragility come from the fact that the  $N\equiv N$  (**N-Triple-Bond-N**) of *elemental*  $N_2$  is so supremely Strong & Stable that it drives  $NH_3$  to decompose back to  $H_2$  &  $N_2$  gasses at Far-lower temperatures and *much* more easily than can Heat force  $CH_4$  back to  $H_2$  and *solid* Carbon.

In summary, *Ammonia* is a *tricky* molecule to make cheaply without *Very-pricey* Upfront CAPEX, requiring *Boat-loads* of  $H_2$  that's truly Pure, and which dirty **Coal** has a *Tough time making affordably*.

### More Thoughts on preparing Feed for Ammonia AND Methanol

Shell's implications in the Presentation that its process for making *Methanol from Coal* is simple & straight forward are *rather misleading*. This is because in order for *Coal Syngas* to have the right  $H_2/CO$  ratio for methanol, it must be reacted with *additional*  $\sim 1000^\circ C$  Steam. And the *only* way in which that can be accomplished is thru yet another Process-train called "Steam reformation" – pretty *pricey* process equipment whose *High* temperatures and *consumable* catalysts force the tricky "Water-gas Shift" reaction to take place.

So Shell will have to specify yet-*another* Process Train for the following reaction & associated controls:



-- all within a narrow Temp-window from  $550^\circ C$  but it can't exceed approximately  $750^\circ C$  for fear of favoring the retention of CO because the hotter you make the process, the more CO wants to stay formed, than anything else. Then you need to add intimate contact with the easily-*poisoned* solid catalyst, plus heat supplied at  $600^\circ$  to  $700^\circ C$ . to satisfy the significant *Endotherm*.

You have to apply that heat very carefully, then afterwards you get *back* the excess unreacted hydrogen (that went '*along for the ride*'), plus one *new* mole of hydrogen, plus the CO being turned to  $CO_2$ . Also, since the latter is a Lewis Acid, you have to remove all that Acid-gas from the freshly generated hydrogen. But you *wouldn't* want to be forced use a caustic scrubber, because calcium- and especially *sodium-hydroxide* – the cheapest caustics – are still *too* expensive for the low profit margins that Shell anticipates here. And what would they do with the resulting calcium carbonate, a.k.a. *limestone*, which is totally insoluble? Also, the resulting sodium *carbonate* (or Washing-soda that comes from *Caustic-soda*) holds only a *Fraction* of the value held by sodium *hydroxide*.

So due to the cost, Shell Licensees shall likely have to remove the  $CO_2$  by sequestering it with *ethanol amine* or the like, which is analogous to trying to remove  $CO_2$  from coal flue gas in order to sequester and "store" the gas in *massive* quantities. (the Latter has **Never** been economic (e.g., the attempted *commercial* sequestration facility in Kemper County, Mississippi, and Norway's STATOIL, near Bergen, where both were forced to shut down their facilities because their Economics were declared "*totally unaffordable*." Politicians still persist in scrubbing  $CO_2$  out of effluents, which will never happen due to the stubbornly HIGH Costs...)

The acid  $CO_2$  that will be in enriched hydrogen gas has to be removed. Whatever "Removal Train"–a *Pricey* process– is going to require *Highly-purified Hydrogen* gas, so Shell's poor licensees will have to capitalize still yet more process trains to remove both  $CO_2$  and *Water* vapor. Because the highly-*polar* jewel molecules will likely *poison* the iron copper oxide catalyst for ammonium. Thus acquiring all the Process Trains necessary for Ammonia Manufacture from Coal (vs. from Natural Gas) will be *Very* CAPEX-*intensive*.

My question then is: Where in the world is cash-strapped India going to get all the capital required to erect and maintain the following **Seven Process Trains** in the succession of Methanol Factories it proposes build across the country to replace diesel?

Here's a list of the process trains:

## Process Train 1

The most expensive Process-train is this “Syngasser”, where Shell’s reactor + its (extensive) *auxiliary equipment* pyrolyze *Coal* into *Syngas*.

The **Syngasser** P-train will require *Super-CAPEX-intensive* equipment, especially considering that it must capture & *contain Lava-like*, highly-viscous minerals that soon cool into a Hard-to-manage *Super-viscous, glassy Slag*. As the coal *Minerals* haven’t been oxidized with *Excess* oxygen as they are in a Power-plant, they wind up more like a molten, *glassy Melt* of minerals than like some *power-plant Ash*.

The *reducing* hydrogen-gas / carbon *monoxide* environment of the Syngasser will create corrosive forms of Sulfur – **S**-structures that are polymeric [*lots of members in the chain, e.g., sandwich bags*] & *oligomeric* [*a few members in the chain, e.g., synthetic lubricants*], yet whose ends are bound *involatily*, initially to Alkaline metals in the molten minerals. And that means that all the metals in their *refractory* Coal-to-Syngas reactor that see *molten Ash* must be Fluoride-passivated, because the more common conventional oxide passivation will be destroyed –either dissolved or *reduced* to metals by the chemically-*reducing* Carbon Monoxide and the *highly-reducing* Hydrogen.

However, not even *Fluoride* may be totally resistant, because the molten silicate- & aluminate- Glass-salts are capable of wiping away fluoride coatings like ferrous/ferric (**Fe**, Iron) & especially Chromium fluorides, necessitating protective coatings of *Rare-Earth* fluorides over all such structures. Because once the Oxide or Fluoride films are gone from metal surfaces, the elemental sulfur – which is always present to the tune of ~1-5% in most coals – is going to eat through the structures’ metal *Grain-boundaries*, and *destroy* their structural integrity after just a few years, *or less*.

## Process Train 2

A very *Energy-intensive* **Cryogenic** facility will have to be *capitalized* to separate Liquid **Oxygen** –*LOX* [*Lóks*] –from the Air over India. What will require such painful CAPEX and **ÓPEX** is the above **Syngasser** (*Sim-fully Energy-intensive!*): if **P-train 1** were stuck with Air in *lieu of LOX* for combustion, its **gross** Coal-consumption & Coal-**ash** production would *kill* the Syngasser, *economically*. And this LOX-process will demand *more* CAPEX and Way-more electricity (**ÓPEX!**) per *Liter of LOX* than a Cryo-LNG facility will per *Liter of Liq. Nat. Gas*.

But without **P-train 2**, the #1 P-train **Syngasser** would never have made it *even to the Drawing Board* !

## Process Train 3

P-train **Three** is an *Energy-intensive* “*Water-gas Shift-reactor*” *Train* – a train that is absolutely required to be able to make ammonia. Just coal to Syngas isn’t going to get them there. You really need natural gas, just pure methane, and two moles of water to make 3 moles of hydrogen if they really want to make ammonia. So for making two moles of ammonia from one mole of N<sub>2</sub> you just need one mole of H<sub>2</sub>O and one mole of CH<sub>4</sub>. The only facility you need to do this is a water gas shift train. It uses inputs of CO and H<sub>2</sub>O or hydrocarbons to make hydrogen and basically CO<sub>2</sub>. Then you have to separate all that CO<sub>2</sub> out of the hydrogen and make sure that it’s Bone dry before it goes to any ammonia reactor facility.

## Process Train 4

This is the **Hydrogen-gas Purification Facility** that is absolutely required to be able to make NH<sub>3</sub>, ammonia. Shell Licensees shall likely have to remove the CO<sub>2</sub> by capturing it with *ethanol amine* or the like. This is tantamount to removing dilute CO<sub>2</sub> from Fluegas which has proven to always be too expensive to be practical. It’s *not* going to be *economically* Pretty !

## Process Train 5

This is the Fischer–Tropsch, or F-T train. It really has highly Exothermic reactions that must be controlled to temperatures far below 400°C. But they release energy so they want to self-heat – so the design must have *really* efficient heat transfer built-in and undoubtedly Over-designed (\$\$!).

Also, the F-T reaction occurs where hot Vapors (at *High* velocities) come in contact with **Solid catalytic Surfaces**, meaning *humongous* surface areas and super-Tall F-T equipment.

Thus *this* Process train, due to its huge size and its complex temperature and pressure controls, is the second most costly after the **Syngasser** (P-train 1 on page 3).

Such a giant F-T process train is not easy to engineer or build, seeing how extremely *exothermic* and rapid its reactions are in making Hydrocarbons & other *Stable* structures like -C-OH and H-OH from H<sub>2</sub> + the truly-“loaded” molecule “C≡O” (+whose *C-Triple-Bond-O* shorthand represents the *actually bonding* of a CO molecule!).

Relative to *other* diatomic molecules, the *C-triplebond-O* molecular bonds of C≡O grow *stronger* as temperatures rise, with hot *Coke* in an Electric Furnace capable of robbing Oxygen from CaO (Calcium Oxide) to form C≡O plus CaC<sub>2</sub> (Calcium Carbide). But at temperatures from *circa* 400°C and down to Room-temperature, C≡O *Really wants* to react with everything, including tightly binding onto the Fe ion of the Hemoglobin in one’s blood -- this will keep the blood’s Iron-ions from carrying Oxygen.

So CO is very reactive normally, unless at temperatures *circa* 1,000°C and higher. Thus from the atmospheres of *Stars* plus Super-hot *Planets*, our astronomers can *see* the Signature-vibrations via radiation from C≡O. Although carbon **dioxide** (O=C=O) ultimately *won't* hold together in such atmospheres, after the “loaded” CO<sub>2</sub> looses an *Oxygen* atom (as from bumping into a *plentiful* H<sub>2</sub> molecule), the resultant C≡O could survive for eternity.

Info that has been shared on the several pages preceding are undoubtedly big Reasons for **SASOL** *deciding to stop funding new F-T processes*. **India** ought to follow Sasol’s lead and example.

**Process Train 6** (to edit; *this train exists to keep P-train 1 economically Viable by trying Tenaciously to find some-possible-way to beneficiate, or just to Deal-with the Syngasser’s cursed/Hellish Slag-solids...!*)

The reason why Shell set an operating temperature of nearly 3,000°F in the core of the Syngasser is that *This* must operate at the *high* temperature at which the *Minerals* of most Coals become fluid enough to flow well. However once cooled, the molten Coal-minerals will form glasses that are high in both SiO<sub>2</sub> and Al<sub>2</sub>O<sub>3</sub> with respect to Alkaline oxides (Ca, Na, Mg, K, and Ba) -- which *Alkaline oxides* are ‘viscosity-reducers.’ Because Coal minerals are typically deficient in the *latter* oxides, they will form *glasses too viscous* to ever flow at *Reasonable rates* down the walls of reactors that run more economically at 1000-1100°C.

But if Shell were to simply allow the **3,000°F** slag to cool down (to ambient temperatures) in cheap thin-walled 55 gallon drums until solidified, the resultant amorphous glass would be much more costly and difficult to handle than if they could make an affordable granulation or powder by spraying or otherwise atomizing the glass *while still molten*. What is more, its still-significant alkali content [which highly irritates the lungs and skin] will make handling any divided form *quite expensive*.

Taking into account that Indian coals typically contain 20-40 weight% of such ‘coal-ash’ minerals, Shell’s licensees will have serious difficulty finding any destination for this solid slag, regardless of how much they are willing to pay someone to take it off their hands.

*Page 7*, of Shell’s presentation opens an engineer’s eyes to the challenges of keeping Shell’s coal to Syngas reactor-piece stable and structural at internal temperatures often above 1,600°C while operating under high pressures in excess of 45 atmospheres, often greater than 600 psi-g. They are relying on

water-cooled molten slag to contain this high-temp, high-pressure environment. What do they do with that slag once it falls out of the reactor? There's new slag from fresh coal every day, several hundred tons from the 30% ash coal they will be utilizing.

When the slag solidifies it becomes an *obsidian*, volcanic glass. They really have to alloy it with something -- like sodium carbonate that will decompose into sodium oxide at slag temperatures. This will lower the viscosity of that slag so they can spin it on a centrifugal flinging disk that will break that slag into little micro-spheres flying through [aerate] some cold nitrogen or air – and then capture that as glass beads. But the glasses don't react with water or anything very reactively. They really need to make these glass beads hollow so they can be formed into insulation. But that is neither Easy nor Cheap to do.

So they are going to have to grind down the volcanic glass, which is *also neither Easy nor Cheap*. Glass is a super-cooled liquid – so I don't know what they are going to do with Multiple tons of slag *each and every Hour*. It's not as easy to handle as coal-ash that was burned in a power plant with an over-sized boiler, as is common in India. In these boilers, the excess air keeps the coal-ash slag particles at lower temperatures so the minerals didn't adhere together and didn't completely melt, then they get quenched, and then they filter them out with centrifugal cyclone separators, and use bag filters for the fine particles.

For ourselves, we want to keep the minerals as solid as possible, never expose these coal-ash minerals to more than 150°C. Once our Hydrocracking-units are running, the finest Minerals-from-coal particulates that manage to enter our reactors could accumulate, since these mineral oxides are pretty inert. But we will prevent their Build-up to the point of the minerals impeding the fluidity of our Liquid, homogeneous catalysts: we will simply chlorinate these oxides to their volatile Chloride salts. These deoxychlorination reactions will transform the Oxides of Si, Al, Fe (iron), and of even Ti & P into their respective Chlorides, which are easily separated into ~pure chloride Liquids that have Real commercial value. There's a need for them as catalysts and reagents.

**This train exists** to keep **P-train 1** economically *Viable* by trying *Tenaciously* to find *some-possible-way* to beneficiate this viscous Slag, or just to *Deal-with* the **Syngasser's** cursed/Hellish **Slag-solids...**!)

On *Page 9* of the Shell presentation, it was very dissatisfying seeing that Shell made no mention of just how they will shift the hydrogen-carbon monoxide ratio from one that comes out at 1.5 or 1.75 (at *best*), to something that exceeds 2.x [ideally 2.1 to 2.3] in order to form methanol; and also to a ratio that is essentially *infinite* for making ammonia under energy-intensive "*Haber –Bosch*" (an artificial **Nitrogen fixation** process that uses mixed-metal *oxide* catalysts to convert *purified* elemental Nitrogen (N<sub>2</sub>) to ammonia (NH<sub>3</sub>) by Reaction with *purified* Hydrogen (H<sub>2</sub>) under *high* temperatures and pressures).

On *Page 15* of the Shell presentation, they fail to clarify what the header, "Average O<sub>2</sub> Load (%)" actually means. For example, is it the sum of {pure O<sub>2</sub> fed + the O-content of the coal}? This would be important to know in evaluating their efforts.

The problem from Shell's making the minerals from coal-ash mostly molten, above 1,600°C, to keep the resulting slag molten and flowing down the walls, so:

- How are they going to get rid of this stuff?
- How are they going to handle it?
- If it solidifies into the bottom of the **Syngasser**, it will become practically *irremovable* and necessitate unaffordable Shut-downs for *painful* maintenance...
- How do you dispose of several hundred tons of this obsidian a day that is not totally inert? It will be quite alkaline. It's glass based on silica, but it has excess calcium, magnesium, sodium and potassium oxides – and there's not enough phosphate to neutralize all those things. Silica doesn't neutralize, silica is a super weak acid from 10 to 100 times weaker than carbonic acid.

- When rain falls on this obsidian glass it will leach things out of it because silica will degrade to silica gel and all the metals will come out in the rain water. One good thing about that glass is that the mercury, the selenium, and the arsenic will be in reduced forms – it will be tied up with sulfur that is immiscible with this glass. **However**, the *molten Sulfur & Poly-sulfides* –whose S-S bonds are reactive towards **Structural Metals**– are going to *stick* on the metal surface of the gassifier wall, eating into its grain boundaries & causing premature *Structural Failure*.
- That molten slag is going to wipe off any film on that wall, whether it's fluoride or oxide, because it is a solvent. The elemental sulfur in it will still be soluble, it won't go out as a gas because it will be like poly-sulfides. The alkalinity of that glass will keep the sulfur as calcium and potassium and sodium locked to the ends of sulfur chains. It will be a long sulfur molecule with 3 to 8 sulfurs in a ring, and there will be negative charges on those rings and/or ends of the chain, and metal cat-ions to balance that. The sulfur won't boil out. There's a lot of free reactive sulfur bonds that would rather be *fool's gold* (i.e., structural-**Iron** sulfide), or Nickel sulfide (**NiS** being the native form of Nickel in its ores).
- Thus, the Unavoidable **Sulfur** is simply going to corrode things *constantly*.
- There is going to be a Lot of painful downtime caused by Sulfur-embrittlement of P-train *structures*.
- Fortunately, the Coal processes we utilize are *more-Satisfied* Sulfur than are elemental **S** or *poly-sulfides*.

It is too weak a reducing agent here to chemically *remove Any Oxide* and/or Fluoride films from structural metal surfaces.

And the H<sub>2</sub>S we make will simply get scrubbed out by basically *Water*, once the H<sub>2</sub>S is aqueous, we will either *disproportionate* (preferred) or oxidize it to *solid Sulfur* (**non-corrosive** cf. *Liquid S*) and either *Hydrogen gas* or to water. The *nano-fine Sulfur* will *best* stay in the water in which it was formed. This will then be blended with our fertilizer solutions in accordance to the pH that the farmer's field requires for its greatest productivity.

**Process Train 7** This one is needed to keep P-train 1 economically *Viable* by trying *Tenaciously* to find *some-possible-way* to beneficiate, or just to *Deal-with* **the Syngasser's** cursed/Hellish **Slag**-solids !)

**This train** is the *Ammonia-Reactor Facility* [“**ARF**”], an almost separate factory complex that will require Very-high CAPEX **and** OPEX.

Most *impartial* engineers would never suggest building an ARF associated in association with a Syngas Complex.

Furthermore, what follows is provided to persuade India to cancel her Plans for *Any syngas-fed ARF's* in the Future.

## Efficiency & Environmental Problems with *Plain Ammonium & Urea*

**Big problems** are caused by pushing plain Ammonia and/or Urea molecules upon Farmers, unfortunately.

Wanting to provide its people with new sources of “N” –meaning *plant*-beneficial forms of *Nitrogen*– why should India just to stop at ammonia, or stop with two moles of  $\text{NH}_3$  that some Factory has temporarily tied up as a Solid with a mole of  $\text{CO}_2$  ?

I say *this* because Ammonia should *be the Basis* to make more *Field*-efficient Amines and amino-carbon-phosphate compounds, and also because the introduction of *plain* or “*Temperature-tied*”  $\text{NH}_3$  into Indian farmers’ fields will likely lead to *several Huge* environmental problems.

**Solid** urea –compared to *liquid* ammonia – actually costs more money to make, and especially to deal with in getting its N-values delivered effectively into farmers’ fields. All this is because the farmers cannot afford equipment that handles liquid Ammonia, which is best-handled like *liquid Propane*. And ammonia – *when it is injected with little fingerlike mechanisms several inches under the surface of Soil that has some moisture* – actually bonds firmly and *chemically* to the surface of soil particulates & solids. In this situation, the ammonia will absorb pretty *permanently* into the soil and *little* will be lost to the Air.

But farmers often can’t afford or don’t have the necessary equipment for enviro-Safe & *efficient*  $\text{NH}_3$  injection. When *aqueous* ammonia is poured or granular Urea is cast onto the Top of the soil –*typical* of how the least-wealthy or -educated farmers try to enrich their fields with N – a certain *significant* % of the application’s  $\text{NH}_3$  molecules escape into the Air. In the case of injecting  $\text{NH}_3$  in liquid or aqueous forms without *well-penetrating* equipment, the Air-losses are certainly more significant than those from solid or aqueous Urea. But bacterial-catalyzed cleavage of Urea to  $\text{NH}_3$  does result in *some*  $\text{NH}_3$  emissions, and whatever gets emitted to the atmosphere can get oxidized to  $\text{NO} + \text{NO}_2$ , and these reactive intermediates will contribute to *photochemical* smog before they are ultimately washed out as super-dilute  $\text{HNO}_3$  in far-away rains.

**What Indian Farmers really need** in the way of N are chemical forms that are way more *permanent* in the soil, and much, much Slower to oxidize into the *Nitrate anion*,  $\text{NO}_3^-$ , which *can’t* adhere to Soils.

The problem with introducing N as something that turns into  $\text{NH}_3$  quickly is that Soil bacteria see it as food and rapidly “burn”  $\text{NH}_3$  or its *protonated* form  $\text{NH}_4^+$  – the ammonium *Cat-ion* – to “slippery” nitrates. The resulting *Nitrate anions* will no longer bind very well with anything, and the next round of rain will wash most of this “still-delicious” Plant-food far away from the farmer’s field, escaping in multiple directions, *such as into the*:

- Groundwater, out of reach of the plant roots, but contaminating well-water, potentially making for some serious “Met-hemoglobinemia”, [nitrates are reduced by  $\text{O}_2$ -starved soil-bacteria into nitrites, which are toxic to *hemoglobin*]. *If not medically treated promptly*, this blood condition in which the Red-cells’  $\text{O}_2$ -*carrying capacity* is compromised can threaten the Health, and even Life for the young and the elderly.
- Run-off from water-saturated soil into drainage ditches and streams
- Lakes, ultimately killing freshwater fish, crustaceans, etc.
- Ultimately into some salty sea, like the now-*Dead* western Gulf of Mexico. **There** fishermen have to go on the far-side of the Yucatan Peninsula before they can catch some serious fish anywhere ~*Near* that *dead gulf*...

And about the Bay of Bengal, Bharat should not want what's happened to Mexico's **Gulf** to happen on Indian's Eastern Shores !

The worst thing about nitrate-runoff is that the resulting algae blooms steal oxygen from waters, both fresh and salty, wherever the Nitrate levels exceed just a few parts per million. The *Lack of O<sub>2</sub>* from the Excess algae in either fresh or salt waters will kill the aquatic life that People & their Environment *truly require*.

A far more serious problem arising from all this quick-release NH<sub>3</sub> and Urea Nitrogen is that the Farmers have been given *Few* options and *No* coordinated abilities to slow down the *Disappearance of N to Nitrate*. However better **N**-enduring options & the ability to get *Better results for Money spent* can be easily realized by “N-valorization” or “N-Beneficiation” that will employ amines, alkanolamines and aminoalkyl – phosphate compounds from our own *Local* factories.

Our fertilizer solutions come with aqueous Soil-sulfur & “complexed” Phosphorus (**P**) compound that came custom-formulated to address the soil-type of the intended fields, to keep its **P**- & especially its **N**-content *Plant*-available for *Multiple* months (if not *Years*), and with *resistance* to being washed away by *Monsoon* & other rains. Only after naturally-slow chemical hydrolysis of C-P bonds to new compounds containing –CH + HO-P- units can the crops, pretty much independently of soil bacteria, take in the phosphorus as the typically-*sticky* **Phosphate** anion, *e.g.* <sup>-</sup>O-P=O(OH)<sub>2</sub>, which are fortunately a *Lot* less soil-mobile than nitrate (!).