PETROLEUM COKE DENSI-FEED® SYSTEM EXPERIENCE SUMMARY

www.petcokefuel.com

A Matrix Engineering Company ~ We put the Energy in...So you get the Energy out!!

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Matrix Engineering is a consulting engineering firm founded in 1995. Matrix developed a strong background and expertise in handling difficult powders in the Chemical Industry. We specialize in storing, feeding, batching, conveying and packaging bulk materials, both powder and liquid. Our expertise in process controls also compliment our projects.

Matrix Industrial Systems, Inc. was created in 2007 for the specific purpose of promoting and providing our patented pulverized fuel feed and delivery system along with its specialized equipment. Our goal is seamless implementation of our designs through providing a complete system package, even to the point of turnkey installation as well as preventive maintenance and emergency service calls.

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DENSI-FEED® SYSTEM ORIGIN
Matrix initially began working with ground petroleum coke in 2000. PeTroCoke, Inc., a supplier of ground petcoke, contacted us to provide engineering services for upgrading their existing grinding facility. After successfully completing this project, we used our strong background in feeding and conveying problem powders and began developing an advanced feeding system for burning ground petcoke in lime kiln operations.

INDUSTRY LEADER
Since that time, we have become the industry’s leader in design of petcoke feed systems for domestic paper mills. Our unique patented DENSI-FEED® system is unmatched for flame stability and its design is based our ability to feed a fine powder as easily as metering a liquid or gas fuel. We have PetCoke delivery systems at 14 different mills and have a proud history in innovative design for pulverized fuel systems.

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**PROVEN FUEL AND PROVEN DELIVERY SYSTEM**

PetCoke is an economical choice as an additional fuel capable of displacing up to 70% of Fuel Oil and up to 85% of Natural Gas. PetCoke is relatively inexpensive with little or no price volatility since it is a waste stream of the oil refinery. Depending on the ever changing price of fuel, a Mill which burns 100% fuel oil can typically save between 25% and 50% of their total kiln fuel costs by co-firing with PetCoke. PetCoke, prepared for the lime kiln, is a fine powder with both cohesive and flushing tendencies. Controlling the feed consistency of this problematic powder is the key to unlocking an excellent fuel for the kiln which is on par with fuel oil in terms of kiln heat profile and lime re-burning quality. Our patented DENSI-FEED® Pulverized Fuel Feed and Delivery System delivers precise and predictable fuel flow of this very difficult powder.

**PATENTED TECHNOLOGY**

Matrix also recently received its patent for its process of precise feeding of fine powders directly from a large storage silo. This is a continuous feeding cycle with instantaneous feedback and control of the powder as it leaves the discharge of the feeder. This is crucial for applications such as powdered fuels in kilns or boilers.

**MATRIX PRESENCE IN INDIA**

Matrix has pioneered most of the pulp and paper sector of the fuel grade PetCoke market within the United States. Matrix also recently provided the first PetCoke fuel delivery system for a lime kiln in India. This project was highly successful by all measures! Since natural gas is not an option in India, petcoke will co-fire and displace the more expensive fuel oil. Petcoke is also a very dry and radiant heat that is superior to Producer Gas and Biogas. Therefore petcoke is THE BEST CHOICE TO CO-FIRE WITH FUEL OIL.

In 2014 Matrix Industrial Systems, Inc. commissioned its first DENSI-FEED Pulverized Fuel system in India with the assistance of our partner AGRO Pulping Machinery (P) Ltd. AGRO has a wide background and expertise in the pulp and paper industry and is now our representative in India.

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**MOBILE TEST UNIT**
Matrix Engineering has recently developed and commissioned a Mobile Test Unit, capable of providing excellent and predictable pulverized fuel feed to your Lime Kiln burner.

Our focus on the Mobile Test Unit (MTU) is to provide performance comparable to our permanent system. The system is designed to be entirely mobile for quick deployment and require as little work and preparation as possible from the Mill.

- **Full Scale / On Site Testing**
- **Fully automated system with proper instrumentation and trending controls.**
- **Completely MOBILE with essentially no capital investment from the mill.**
- **Quick Deployment, Set-up and Breakdown by Matrix are included. (no hidden costs).**
- **Steady, Reliable and Predictable fuel flow to your kiln.**
- **Determine actual Environmental Emissions, Process Impacts and Profitability at your own kiln.**
- **Establish your PetCoke supply and pricing.**

There is virtually no capital investment required from the mill in order to conduct a test with Matrix Engineering. The Mobile Test Unit (MTU) is completely mobile and requires only a 480V power feed and a compressed 1” air line from the mill. Typically we can set up the MTU and burn petcoke within 48-72 hours of our arrival.

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This is a high quality feed system outfitted with industrial controls and instrumentation for trending the feed system performance for comparison to your downstream process and/or environmental emissions. All of this can be controlled from the comfort of your control room utilizing wireless communication and our provided PC interface.

The use of our Mobile Test Unit allows you to determine and prove the economic improvement that burning Petcoke can have on your operation.

**TOTAL SOLUTION**
Matrix can provide the total solution – engineering and system provider for your facility. Matrix has dedicated the past decade to perfecting our DENSI-FEED® technology and is focused on seamless implementation for your fuel conversion project. Matrix currently has the most PetCoke delivery systems on the market for the pulp and paper industry. The success of our innovative design continues to result in future business. Let Matrix help you aim toward lowering your energy costs today.

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Matrix provided the complete system engineering equipment package for IP in Prattville, AL. At this particular mill, we replaced a direct fire system for burning PetCoke in the kiln with our modern DENSIFEE® indirect fire system. This system was designed to accept PetCoke from a pulverizer feed the lime kiln burner from a 180 ton silo. Currently they are able to fire PetCoke and fuel oil and are feeding at rates as high as 3.00 tons per hour (90 MMBtu/hour).
Matrix provided the complete system engineering and equipment package for J K Paper Limited, Unit: JKPM. This was the first installation in India for petcoke fuel burning in a Lime Recovery Kiln. Our DENSIFEED pulverized fuel system is performing flawlessly alongside fuel oil at 65-70% substitution levels in a kiln capable of 300 mtons CaO per day. This system was designed to accept petcoke from a bulk bag delivery into a 240 mton silo. Also, of significant importance, Matrix delivers the fuel through our delivery convey system burner over 650 ft (200m) away.

In addition to our patented system, Matrix provided construction management, commissioning and on-site training services for the mill.
Matrix provided the complete engineering package for a dual discharge petcoke delivery system for Smurfit Stone Containerboard Division in Hodge, Louisiana. The system was designed to feed two lime kiln burners from a common 180 ton silo. A dual discharge hopper bottom was specifically designed for two petcoke feeders. It included dual pneumatic convey systems with variable rate blowers to deliver petcoke to the Coen burners in accordance with the manufacturer's specific air flow requirements. The convey distance of the petcoke was in excess of 600 feet. The system allowed the mill to substitute up to 90% ground petcoke for natural gas in each of their lime kiln burners. The control of the Matrix feed equipment was integrated into Smurfit Stone’s existing DCS. Matrix provided all the civil/structural, mechanical, and electrical engineering for the project.
Matrix provided the system engineering and critical equipment packages with silo for a
dual discharge petcoke delivery system at Alabama River Pulp (ARP) in Perdue Hill,
Alabama. This system was designed to accept petcoke from rail or truck and feed two
lime kiln burners from a common 180 ton silo. A dual discharge hopper bottom was
specifically designed for two petcoke feeders, though initially, ARP chose to implement
the project in two phases and only installed one of the two petcoke feed systems.
Matrix Engineering commissioned the second line in late Spring 2008. A pneumatic
conveying system with a variable rate blower delivers petcoke to the burner in
accordance with their specific air flow requirements. Control of the Matrix system was
integrated into ARP’s existing DCS. Currently they are able to fire petcoke and fuel oil
as well as natural gas.
The first kiln’s system at ARP was proven and tested to 3.0 tph and is currently burning in excess of 2.4 tph of petcoke in combination with fuel oil. Below is a picture of the flame at 2.5 tph with fuel oil.
Matrix implemented an engineering and equipment supply contract for a storage silo and petcoke feed system for Weyerhaeuser in Springfield, Oregon. The system consisted of a 180 ton storage silo and a variable feed system specifically designed for the discharge of ground petcoke. A variable rate blower was used to transfer the petcoke approximately 350 feet to the existing “coke-ready” burner. All controls and display panels were integrated into the mill’s existing DCS system. Matrix provided the civil/structural, mechanical, and electrical engineering for the project. System startup was conducted in December 2006.
Matrix was awarded an engineering and complete equipment supply contract for a single discharge storage silo and petcoke feed system. The system is designed to supply in excess of 3 tons-per-hour of petcoke to the burner.
Matrix provided the system engineering and critical equipment package for Smurfit-Stone in Panama City, Florida. This system was designed to accept petcoke from trucks and feed a lime kiln burners from a 180 ton silo. A pneumatic conveying system with a variable rate blower delivers petcoke to the burner in accordance with their specific air flow requirements. Control of the Matrix system was integrated into their existing DCS. Currently they are able to fire petcoke and fuel oil and are feeding at rates as high as 3.80 tons per hour (115 MMBtu/hour).
WICKLiffe, KENTucky
PETROLEUM COKE DEnsi-FeED® SYSTEM

Matrix was awarded a complete turnkey contract for engineering, equipment supply, and installation of a single discharge storage silo and petcoke feed system for NewPage Corp. in Wickliffe, Kentucky. The system is capable of unloading both truck and rail. Startup for this project was completed ahead of schedule in May 2007.
LUKE, MARYLAND
PETROLEUM COKE DENSI-FEED® SYSTEM

Matrix Engineering was recently awarded a contract to provide a pulverized petcoke fuel delivery system for one kiln utilizing a truck or rail unloading system, storage silo, feed system, pneumatic conveying system, and all the necessary instrumentation. We commissioned this project in October 2008. The system utilizes natural gas and petcoke. The petcoke system provides 90 MMBtu/hour (3.0 tons per hour) to the kiln.

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CAMPTI, LOUISIANA

PETROLEUM COKE DENSI-FEED® SYSTEM UPGRADE

Matrix provided the consultation and engineering necessary to upgrade an existing petcoke feed and convey system. Matrix employed its new 3rd generation design to double the feed rate of petcoke. The existing silo was re-used and retrofitted with the Matrix feed system. We also replaced the existing convey system and instrumentation for delivering the pet coke to the burner nozzle.
Matrix recently completed a contract for engineering and equipment to retrofit the DENSI-FEED® System after removal of an existing competitive system. The previous system was subject to a flush/feed phenomenon and could not provide steady and reliable feed. In its 17 months of operation, the brick in the kiln was replaced on 3 different occasions.

Matrix implemented its improved system and re-used the existing structure and storage silo. Currently this customer can feed in excess of 90 MMBtu/hr (3.0 tph) with a steady and reliable fuel flow to the kiln.

At this particular mill our system interfaces with an Andritz burner.
Matrix provided a total Pet coke Delivery System at Weyerhaeuser Corporation in Valliant, Oklahoma. The system allowed the mill to substitute up to 80% ground pet coke for natural gas in their lime kiln burner. The system consisted of a 180 ton storage silo and a variable speed feeding system specifically designed for the discharge of ground pet coke. A variable rate blower was employed to precisely meet the air flow requirements of the KFS burner. An existing AB Control Logic PLC was used to control the process. Matrix provided an I/O control panel in conjunction with our feeding equipment. Matrix provided all the civil/structural, mechanical and electrical engineering for the project.
Matrix provided a total Petcoke Delivery System at Weyerhaeuser Corporation in Pine Hill, Alabama. The system allowed the mill to substitute up to 80% ground petcoke for natural gas in their lime kiln burner. The system consisted of a 180 ton storage silo and a variable speed feeding system specifically designed for the discharge of ground petcoke. A variable rate blower was employed to precisely meet the air flow requirements of the KFS burner. All controls and display panels were integrated into the mill’s existing DCS system. Matrix provided the civil/structural, mechanical, and electrical engineering for the project.
Matrix provided the consultation and engineering necessary as well as much of the equipment to replace an existing petcoke feed and convey system. Matrix provided new features into the 3rd generation design to double the feed rate of petcoke. The existing silo and chisel bottom were re-used and retrofitted with a dual inlet feeder utilizing Matrix’s new pulverized fuel feed system. We also replaced the existing convey system and instrumentation for delivering petcoke to the burner nozzle.
BREWTON, ALABAMA – PETROLEUM COKE DENSI-FEED® SYSTEM

Matrix has been awarded an engineering and equipment supply contract for a single discharge storage silo and petcoke feed system for Georgia-Pacific’s Mill in Brewton, Alabama. Engineering is complete and we are awaiting release to procure the equipment.

EVADALE, TEXAS
PETROLEUM COKE DENSI-FEED® SYSTEM WITH RAIL UNLOADING

Matrix provided engineering services to MeadWestvaco for a 270 ton dual discharge petcoke delivery system with rail unloading capabilities. The rail unloading line will extend in excess of 600 feet to the delivery silo where petcoke will be fed to two lime kilns.
Georgia-Pacific

PORT HUDSON, LOUISIANA
PETCOKE CONVEYING & FEED SYSTEM
TROUBLESHOOTING

Georgia Pacific contacted Matrix while experiencing problems during start-up of their on-site grinding facility. Our Engineering Department provided assistance for an existing petcoke feed system that was not functioning as designed. We were able to quickly diagnose the problem which involved the conveying air flow for the delivery silo dust collector. The convey air flow was overwhelming the dust collector filter area. We quickly engineered a new 4” line, provided and expedited a positive displacement blower to replace a centrifugal fan, which conveyed the same coke rate using 20% of the original air. This completely eliminated the problem.

Georgia Pacific then asked Matrix to look at some chronic feeding problems they were experiencing with their existing burner delivery system. Matrix Engineers evaluated the situation, and determined that it was due to a “bridge and flush” phenomenon, which caused a 20% swing in the average feed rates. Matrix issued a complete report on the problem and recommended improvements.

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Matrix Engineering provided a complete electrical system upgrade and the modernization and controls automation of PeTroCoke, Inc.’s Owensboro, Kentucky plant. The entire electrical system was replaced from the main service disconnect to all of the equipment and instrumentation. The new control system consisted of an Allen Bradley PLC and RSView32 computer operator interface. The electrical upgrade controls a mill feed system, a hammer mill, and a gas-fired burner system for drying the petcoke. Ultrasonic instrumentation continuously monitors the finished product silo and controls a bulk truck load-out system. Matrix personnel assisted in complete system check-out and start-up and were able to minimize downtime without affecting delivery of customer orders. Due to automatic control of product feed and burner temperature, the plant throughput was improved dramatically.

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PETROLEUM COKE FREQUENTLY ASKED QUESTIONS

1. What is Petroleum Coke (PetCoke)?
   - Petroleum Coke “PetCoke” is a by-product of the petroleum industry.
   - Chemically comprised of around 83 - 87% fixed carbon, 4 - 9% Sulfur and left-over volatiles from the coker process.
   - Raw Petroleum Coke is comprised of carbon pellets from 0.125” to boulder size.
   - Ground Petroleum Coke is pulverized to a fine dry powder (approx 90% passing 200 mesh with less than 1% moisture).
   - Pulverized PetCoke has cohesive tendencies and aerates easily.
   - Pulverized PetCoke burns at 15,000 – 15,250 Btu/lb.
   - PetCoke Ignition Temperature: 750 deg F
   - Depending on volatile content of the coke, NFPA classifies both Coal and Coke as Class II, Group F dusts.

2. How is PetCoke different from coal?
   - PetCoke has a much higher BTU content per pound than coal.
   - PetCoke on average has a higher sulfur content than most coal.
   - PetCoke does NOT have spontaneous combustion properties like coal. This allows it to be pre-pulverized, stored, and delivered to a customer without requiring an on-site pulverizing facility.
   - PetCoke is low in ash content at around 0.50%.

3. Where is PetCoke used?
   - Historically, PetCoke has been mixed with coal, pulverized, and direct fired as a fuel for kilns in the domestic limestone and cement industry.
   - Pre-Pulverized Petcoke has been in very limited usage since 1986 in the pulp and paper industry with only three mills using it as late as 2003.
   - PetCoke has been gaining momentum in recent years in the pulp and paper industry. Matrix Engineering is currently leading the way with 15 kiln conversion projects in the pulp and paper industry from 2003 to 2008.

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4. What is the general scope of a PetCoke Conversion Project?

- **ENVIRONMENTAL/PROCESS TESTING**
  - Consider performing a trial burn at your facility to test for environmental and/or process impacts. Matrix can provide a Mobile Test Unit (MTU) for full scale testing at your Mill.
  - Matrix can assist your Mill in obtaining operating permits for both our Mobile Test Unit, and a permanent Petcoke Delivery System.
  - Matrix can also make a process presentation to your mill on the Sodium/Sulfur balance while utilizing petcoke. We can assist your Mill in making these determinations for any predicted impacts on your liquor cycle.

- **PETROLEUM COKE DENSI-FEED® SYSTEM.** This permanent feed and delivery system consists of the following components.
  - A Storage Silo with unloading system for receiving and storing truck or rail deliveries of pulverized PetCoke.
  - An Integral Feed System for metering PetCoke directly from your Storage Silo at a controlled and steady rate.
  - A Pneumatic Conveying System for transferring the fed PetCoke into a pneumatic line to the burner at the kiln.

- **PETCOKE READY BURNER.** This generally consists of a change-out of your existing burner. An experienced PetCoke burner vendor can model your existing kiln and design a dual or tri-fuel burner for PetCoke, Natural Gas and/or Fuel Oil.

- **PULVERIZING FACILITY.** On a more complex scale a pulverizing facility can be added which would receive PetCoke in its raw unground form and pulverized at your mill site. These systems generally require the following components:
  - Raw Coke Unloading and Storage System
  - Mechanized Equipment for Moving the Raw Coke
  - Transfer Bucket Elevator or Inclined Conveyor with Crushers, Magnet and Feeder for transferring Raw Coke to the Pulverizer.
  - Pulverizer with Classifiers, Cyclones and Dust Collectors.
  - Pneumatic Conveying Equipment for Transfer of Pulverized PetCoke to a Storage Silo.
5. Why should I consider using PetCoke in place of my current fuel?

- **PRICE!** Delivered Ground PetCoke will range from $3.50 to $6.50 per MMBtu.
- **KILN EFFICIENCY!** If you are converting from natural gas, we have seen efficiency improvements ranging from 3% to 10% in overall fuel consumption in lime recovery kilns.
- **MONEY!** Our customers begin to save significant money right out of the gate. As the traditional fuel costs swing due to hurricanes, winter demand, and foreign influence, our customers have saved as much as **$600,000 in one month at a single mill** using PetCoke, which historically has been steady, predictable and at a much lower unit cost.

6. Where can I get pulverized PetCoke?

- Currently there are (5) different suppliers of pulverized PetCoke with 6 different pulverizing facilities. *Matrix has experience with all 6 of these facilities and the slight differences in the coke that they pulverize.*
  - DTE Petcoke, LLC has a pulverizing facility in Vicksburg, Mississippi.
  - Oxbow Chemical has a pulverizing facility in the Hunt Oil Refinery in Tuscaloosa, Alabama.
  - PeTroCoke has two pulverizing facilities, with one in Owensboro, Kentucky and the other in Campti, Louisiana.
  - Hiller Group currently has a pulverizing facility in Marietta, Ohio.
  - Quigg Brothers operates a pulverizing facility in Washington State.

7. Why wouldn’t I install my own pulverizer and buy coke in raw form at its cheapest?

- Capital Investment for a complete pulverizing facility is quite expensive and returns are lower.
- Margins between raw coke and pulverized coke are generally much smaller than margins between pulverized coke and standard fuels. Therefore, when the low margin, coupled with the high investment required for pulverizing facilities is realized, then the return on investment is much lower than a delivery system which has a relatively low investment and a larger margin.
- Studies indicate that 3 to 4 lime recovery kilns (6-8 tph) are required to generate enough savings that would support a return on investment that most mills would be willing to accept.
- Operating costs, maintenance and potentially additional manpower also deter most mills from the pulverizing option.
- Pulverizing Facilities are also much dirtier than Delivery Systems, causing potential housekeeping issues and other environmental concerns.
- Project times for pulverizing facilities are considerably longer than Delivery Systems as well. Therefore your capital is initially committed longer without a return.
- **WALK BEFORE YOU RUN!** If PetCoke is going to be a new experience within the mill, we would advise you to step into the process gently and learn as much as you can before

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plunging directly into it with a pulverizing facility. By installing a delivery system first, you have not disqualified yourself from installing a pulverizing facility later. As a matter of fact, 100% of the delivery system equipment will still be needed to deliver coke to the kiln. Therefore none of your previous investment is wasted if you decide to build a pulverizing facility later.

8. What can I expect for a return on investment for a typical PetCoke conversion project with a Matrix Engineering PETROLEUM COKE DENSI-FEED® SYSTEM?

- Depending on the size, number of kilns, and relative fuel costs of natural gas and oil, we have seen our installations pay for themselves in the range of 4 - 18 months after commissioning.
- Matrix has developed a Mobile PetCoke Delivery System which can be used by a customer to realize returns before a permanent feed system is funded. **Using our MTU it is possible to shorten your ROI or even completely pay for your permanent system before you commission it!**
- Matrix can help you determine your PetCoke conversion project costs and likely return on investment.

9. How long does a Matrix PetCoke conversion project take to complete?

- Depending on environmental permitting times, the project length will range from 6 months to 1 year for most systems.
- Our previous experience and immediate system “know how” will provide a completed project in the 6 month range. Our ability to provide both engineering and complete equipment supply have proven very beneficial in shortening project times allowing our customers to see returns sooner.
- Matrix recently completed a complete turnkey delivery system including installation in 5 months and 3 weeks from purchase order to burning coke at design rate.

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10. Can I convert over to 100% PetCoke for my fuel?
   • No. Petcoke can be used as your primary fuel for lime kilns but it requires an auxiliary flame to support combustion. It also requires this auxiliary fuel to bring the kiln up to temperature.
   • Generally we have seen Natural Gas Substitutions in the range of 80-85% for lime recovery kilns.
   • Generally we have seen Fuel Oil Substitutions in the range of 65-75%.
   • The cement industry has much higher kiln temperatures that are capable of sustaining a 100% PetCoke flame. However, they also require an auxiliary fuel as well to warm up prior to bringing PetCoke online.

11. Can I go back to my previous fuel once I have converted to PetCoke?
   • Yes. This is one of the low risk benefits in converting to PetCoke. If, in the unlikely event, natural gas or fuel oil prices fall drastically, then you can simply turn your PetCoke off and use 100% of your former fuel. As more typical higher fuel prices return, you can bring your PETROLEUM COKE DENSI-FEED® System back online.
   • Historically, PetCoke has always been cheaper and steadier than standard fuels. However, the ability to switch over to another fuel proves helpful when necessary maintenance is required on the PetCoke Delivery System. This allows uninterrupted operation of the kiln when maintenance is required.
12. Can I use my existing burner for PetCoke?
   - Typically not. Unless your burner has been specifically designed to handle a pulverized powdered fuel, you will need to procure a new PetCoke ready burner.
   - We would suggest using a burner vendor with PetCoke expertise in the Pulp and Paper arena. KFS (Kiln Flame Systems) and Coen are currently two burner vendors with good experience in the domestic pulp and paper industry. Andritz has several non-domestic and one domestic burner. **Matrix Engineering has successful projects in place with all three of these burner vendors and can work with any to meet their requirements.**
   - A successful project will consist of a **SUCCESSFUL BURNER AND A SUCCESSFUL DELIVERY SYSTEM!** Our Matrix PETROLEUM COKE DENSI-FEED® System will deliver a consistent and steady fuel stream to the kiln with instrumentation to verify we are meeting the burner vendor requirements.
   - If you want to perform a trial burn with your existing burner, Matrix can help in designing an add-on modification to your existing burner to lower your initial investment.

13. How is pulverized PetCoke delivered to my Mill?
   - Depending on your supplier, PetCoke can be delivered to you by either pneumatic truck or pneumatic rail car.
   - Pneumatic trucks carry a nominal 24 tons of pulverized PetCoke and are unloaded by the truck drivers in around 1 hour.
   - Pneumatic railcars carry around 90 tons of pulverized PetCoke and are unloaded in 2-5 hours by mill personnel. This time can vary depending on the proximity of the rail spur to the storage silo and the attention the operator gives to the unloading process.

14. Will my kiln be down for an extended period in order to make the conversion?
   - Not really. The most intrusive portion of the project would be the actual burner change-out. Depending on the burner deck layout, type of gun, and extent of burner management changes, this generally takes from a 12 hour shift to 2 days.

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- Once the gun is in the kiln, operation can return as before. Whenever the delivery system is complete and ready for delivering PetCoke to the burner, a simple tie-in to the burner’s PetCoke fuel inlet nozzle can be made in a minor 1-2 hr shut-down.

- One advantage to the Matrix PETROLEUM COKE DENSIFEE® System is that it can be completely checked-out, feed consistency confirmed and all equipment fully commissioned prior to sending coke to the burner. Operators can also be fully trained on the full scale process as well, within their own control room, prior to actually sending fuel to the kiln. This makes for a very smooth project “hand-off” to your Operations Department.
15. Are there any environmental risks in burning PetCoke?

- It could depend whether your kiln is equipped with a wet scrubber or an electrostatic precipitator. Within the kiln itself, most of the SO\textsubscript{2} will be absorbed into the lime as Calcium Sulfate, CaSO\textsubscript{4}. As a result, SO\textsubscript{2} increases in stack emissions are generally not as high as often predicted, even with ESP’s. The absorption into the lime is kiln dependant and advanced environmental modeling or trial burn testing is suggested.
- Generally with a scrubber, our experience has been there is no problem with SO\textsubscript{2}, because if there is any resulting SO\textsubscript{2}, then it is absorbed in the wet solution and recycled back to the mud washer.
- On a kiln with an electrostatic precipitator, there could be a problem with SO\textsubscript{2}. This would depend on your existing permit and its limits and state regulations for SO\textsubscript{2} emissions. However, we have several systems operating with ESP’s that have not experienced environmental issues.
- Our Mobile Test Unit (MTU) can be used to determine Environmental Emissions, process impacts and profitability at your own kiln.
- An environmental permit to burn petcoke must be obtained for your kiln whether for a trial burn or a permanent system.
- Depending on your current PSD (Prevention of Significant Deterioration) permit, your Environmental Department may have to revisit the permit and update in order to burn petcoke.

16. Are there any process risks in burning PetCoke?

- Unlike coal, PetCoke is very low in ash content. With around 0.5% inerts, any residual in the lime from burning the PetCoke would be in the form of carbon.
- Our experience has shown this material is normally removed with the grit from the slaker.
- Our Mobile Test Unit has been used in Mills with white liquor filters. No operational issues have been experienced.

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17. Why should I test with Matrix and their Mobile Test Unit?

- **EXCELLENT FUEL FEED** - Our reliable and predictable fuel feed with proper instrumentation and trending eliminates guesswork during the test.
- **NO CAPITAL REQUIRED** - Our Mobile Unit requires essentially no capital investment on the Mill’s behalf. Matrix also handles the set-up and break-down of the unit as a part of the rental agreement with no hidden costs.
- **FULLY AUTOMATED** - Our system is fully automated and easy to use which means a positive experience for your operations department.
- **SAFETY** – Our approach will be approved by your insurance provider.
- **OPERATIONS EXPERIENCE** - Matrix has Lime Kiln Operating Experience on staff which can help you develop your testing and permitting strategy.
- **BRIDGE TO A PERMANENT SYSTEM** – Once you experience the MTU with its ease of use and fuel savings you will want to bring it back after you receive your permit.
- **NO STRINGS ATTACHED** – Matrix does not have any strings or hooks in their rental agreement that would obligate you to buy any products or services from Matrix in the future.

18. What about burning NCG’s or SOG’s with PetCoke?

- One of our installations was in a 300 tpd kiln that was used as a back-up incinerator for NCG’s (both LVHC and HVLC). No problem was experienced when burning either or both of the NCG’s that could be related to burning the petcoke.
- We’ve also seen good success burning SOG’s with PetCoke if your permit will allow.
19. Are there any product quality risks for white paper mills that burn PetCoke?
   - We have not seen any carryover in the white liquor to the digester.
   - This has been supported by installations in bleached pulp and coated paper operations.

20. I've got two kilns. Do I need two storage silos?
   - No. One silo can be designed to feed two kilns. This silo would have a dual discharge bottom with two Matrix Densi-Feed® Systems underneath.
   - These dual systems are very economical since they share a common silo. Installation times and costs are very similar to single feed system units.

21. Is it going to be difficult for my operators to balance two different fuels in the kiln?
   - This depends on your system. PetCoke is a very fine powder with cohesive tendencies and is extremely difficult to feed consistently without the proper equipment. PetCoke also aerates easily and flows even better than water when aerated. Its cohesive nature and tendency to aerate contribute to a "BRIDGE AND FLUSH PHENOMENON". This is a natural and frequent issue with improper equipment. A bridge occurs over the discharge PetCoke hopper which starves the feed system. Then this bridge collapses and aerates the PetCoke creating a massive flush situation. Your previously starved feed system flow then spikes to deliver much more fuel to the kiln than you were asking for. This can certainly affect the operation of your kiln in a detrimental way.
   - Matrix's Patented Matrix Densi-Feed® Pulverized Fuel Delivery System solves the "BRIDGE AND FLUSH PHENOMENON". This results in a predictable and consistent fuel feed for responsive and smooth kiln operation.
   - Our system is capable of automatic control of the feeder to a baseline setpoint or even a level of fuel substitution!
   - Matrix Fuel Cascade Control allows you to enter a substitution level for the petcoke and modulate all fuels to maintain this substitution as the load changes on the kiln. Only our Densi-Feed® system gives you instantaneous feedback and control of your petcoke flow. This allows you to modulate all fuels together and thus maximize your petcoke substitution and savings. Only Matrix is capable of complete cascade control on the fuel feed to your kiln.

We put the Energy in...so you get the Energy out!!
22. My area’s climate is humid and wet. How will moisture affect the flow of PetCoke?

- Not a problem. PetCoke is a by-product of the petroleum industry. It is mostly carbon with a few oil-based volatiles. PetCoke is not hygroscopic or “thirsty”. It is hard to wet down and floats on water.

23. Are PetCoke Delivery Systems a dirty housekeeping nightmare?

- This depends on your system. PetCoke is a very fine powder with the consistency of talc. It aerates easily and flows even better than water. The least amount of pressure and a warped flange, bad gasket, or flexible boot type connections usually means a big mess. Also system filters need to be outfitted with proper media and appropriately sized for handling this material.

- **NOT MATRIX SYSTEMS!** Our Patented Matrix DENSIFEED® Pulverized Fuel Delivery System operates under a controlled vacuum and utilizes heavy flanges for amazingly clean approach to handling PetCoke.

- In general, we’ve found that pneumatic unloading of trucks and railcars is one of the cleanest ways to unload and distribute process powders. Primarily the biggest risk with pneumatic unloading is overfilling or over-pressurizing the relief valve. **Our Systems give you complete control to avoid silo overfilling as well as keep the silo under a vacuum while filling.** We can provide an unloading system complete with the unloading blower that will allow you to interlock the silo level with the blower so you know you can accept a full truck prior to beginning to unload.

- We can also provide complete filter information with anticipated loading to your Environmental Department for the permitting process.

*We put the Energy in…so you get the Energy out!!*
24. I am out of space near the hot end of my kiln. Is a PetCoke conversion project still viable?

- **Our Matrix System can be placed up to 750 feet away from the burner** and possibly further depending on the route. This has made the location of our system a non-issue in all of the cases thus far. We are very flexible with our layout and want you to consider all of the possibilities including:
  - Truck/Rail Traffic and logistics.
  - Control Room Location.
  - Access to the Kiln or Delivery System for Maintenance.
- Once a location is chosen based on your specific requirements site, our footprint is relatively small and easily placed.
- Adequate room directly behind the kiln hood is necessary for change-out and maintenance requirements on the burner itself. Consult with the individual burner vendor on spatial requirements and burner support. However, PetCoke ready burners are not inherently larger than most oil and gas burners. Therefore, it is doubtful that burner space will be an issue unless circumstances are extreme.

25. What about fire suppression and insurance requirements for PetCoke?

- Depending on volatile content of the coke, NFPA classifies Ground Petroleum Coke as Class II, Group F dusts.
- It has a fairly high ignition temperature of 750 deg F.
- Delivery system equipment normally operates at temperatures well below the ignition point. Nonetheless, Matrix’s delivery systems employ the requirements made by NFPA governing pulverized fuel systems to relieve deflagrations.
- You will need to check with your insurance carrier to determine their requirements for handling pulverized PetCoke. Matrix can assist you in providing information that your insurance carrier may require in making the decision.
- Pulverizing facilities see higher temperatures and may require some form of fire suppression.
- The Matrix Delivery System provides a pulverized fuel burner management valve for fuel isolation from storage as required by NFPA. This valve will work in conjunction with your existing burner management system.

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*We put the Energy in...so you get the Energy out!!*
26. Once I’ve decided to take a hard look at using PetCoke as my primary kiln fuel, what should I do?

- Get your Environmental Department on board. Generally environmental outcomes have been good for our customers who are burning PetCoke. However, environmental questions must be answered and permits obtained before most mills are willing to commit capital funds. Matrix can assist your Mill in obtaining their operating permits by working with your State’s Environmental Permitting Department.

- Consider a test burn with a Matrix Mobile Test Unit. If your environmental department has questions, most all of them can be answered by testing during a trial burn period. Many times trial burn permits are easier to get and can be extended concurrent with the formal permitting process. Test burns are usually paid for by fuel savings and provide additional savings revenue for the Mill during the test.

- Contact potential PetCoke suppliers. Look to them for estimated fuel pricing, shipment methods and costs. They also may be able to help you with some of the environmental questions you may have.

- Contact potential PetCoke Burner Vendors. Getting them on board early is always a good idea.

- Contact Matrix. We can answer your questions regarding delivery systems and kiln operation. We can provide preliminary engineering services to help tie down the cost and scope of a PetCoke conversion project. We can also provide our list of references for you to contact as well as potentially visit one of our PETROLEUM COKE DENSI-FEED® Systems already in service.
27. Why would I choose Matrix over my own engineering department or local engineering consultant?

- **PROVEN SYSTEM!** A Fuel Delivery System must be steady, predictable and consistent in order to fire your kiln properly. There is much more to be considered here than a typical pneumatic conveying system.

- **EXPERIENCE!** Building on our past innovations in handling difficult powders, Matrix has developed a proven PETROLEUM COKE DENSIFEED® Delivery System. Since our initial development, we have been able to fine tune our technology to give you a reliable, steady, and consistent, and inexpensive fuel stream to your lime kiln.

- **TIME!** Because of our experience and know how, we can get you up and running at your design rate faster than anyone. With volatile energy prices in the gas and oil market, shaving a month or two off of the project is very significant.

- **MONEY!** Using Matrix’s proven technology we can help achieve your savings quicker and allow you to maximize your burning potential of PetCoke. Also, it is possible to utilize the Mobile Test Unit at the onset of the project when you receive your permit and begin **SAVING FROM DAY ONE**, shortening the time to realize your ROI.

- **TESTING TO ELIMINATE RISK!** Matrix can provide full scale, on site testing with our Mobile Test Unit. The Unit is fully automated with proper instrumentation and trending controls. It is completely MOBILE with essentially no capital investment from the Mill’s standpoint. The Unit is steady, reliable and can provide predictable fuel flow to your kiln. It can also be used to determine actual Environmental Emissions, Process Impacts and Profitability at your Mill. Your Mill is not contractually obligated to Matrix in any way after the testing has been completed.

- **TRAINING AND SERVICE!** Matrix will train your operations and maintenance department prior to system commissioning. Matrix can also provide on-site service after the project has been placed in operation.

- **LONG TERM!** Based on our past success, Matrix is committed to this industry and will be there for service, training, and other assistance as needed long into the future.

- **FLEXIBILITY!** Matrix Industrial Systems, Inc. can work with you in several different scenarios:
  - Preliminary Engineering and Project Estimates.
  - Mobile Delivery Unit for Environmental/Process Testing
  - Engineering and Critical Equipment Supply.
  - Complete System Provider.
  - Turnkey Systems Including Installation.
  - Maintenance Services and Spare Parts.

*We put the Energy in…so you get the Energy out!!*
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