Status and Control Strategies on Shipping Emission in Shanghai Port

Qingyan Fu
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Outline

1. Shipping Industry in Shanghai & YRD
   - Air Emission in Shanghai Port
   - Control strategies of Regional Cooperation in YRD
1. Shipping Industry in Shanghai & YRD
### 1.1 The world ten largest port ranked by container throughput

<table>
<thead>
<tr>
<th>Ranking</th>
<th>Port</th>
<th>Throughput 2013 (10KTEU)</th>
<th>Throughput 2012 (10KTEU)</th>
<th>Growth rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Shanghai</td>
<td>3362</td>
<td>3253</td>
<td>3.34</td>
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<tr>
<td>2</td>
<td>Singapore</td>
<td>3258</td>
<td>3165</td>
<td>2.94</td>
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<tr>
<td>3</td>
<td>Shenzhen</td>
<td>2328</td>
<td>2249</td>
<td>1.47</td>
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<tr>
<td>4</td>
<td>Hongkong</td>
<td>2229</td>
<td>2312</td>
<td>-3.59</td>
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<td>5</td>
<td>Busan</td>
<td>1768</td>
<td>1705</td>
<td>3.69</td>
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<tr>
<td>6</td>
<td>Ningbo-Zhoushan</td>
<td>1735</td>
<td>1617</td>
<td>7.27</td>
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<tr>
<td>7</td>
<td>Qingdao</td>
<td>1552</td>
<td>1450</td>
<td>7.01</td>
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<tr>
<td>8</td>
<td>Duangzhou</td>
<td>1531</td>
<td>1455</td>
<td>5.24</td>
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<tr>
<td>9</td>
<td>Dubai</td>
<td>1350</td>
<td>1328</td>
<td>1.66</td>
</tr>
<tr>
<td>10</td>
<td>Tianjin</td>
<td>1300</td>
<td>1230</td>
<td>5.66</td>
</tr>
</tbody>
</table>
### 1.1 The world ten largest port ranked by container throughput

<table>
<thead>
<tr>
<th>Ranking</th>
<th>Port Name</th>
<th>Throughput 2013 (10KTon)</th>
<th>Throughput 2012 (10KTon)</th>
<th>Growth rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td>2012</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Ningbo-Zhoushan</td>
<td>80978</td>
<td>74400</td>
<td>8.84</td>
</tr>
<tr>
<td>2</td>
<td>Shanghai</td>
<td>77600</td>
<td>73600</td>
<td>5.43</td>
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<tr>
<td>3</td>
<td>Singapore</td>
<td>55958</td>
<td>53801</td>
<td>4.01</td>
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<tr>
<td>4</td>
<td>Tianjin</td>
<td>50000</td>
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<tr>
<td>5</td>
<td>Guangzhou</td>
<td>45512</td>
<td>43500</td>
<td>4.63</td>
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<tr>
<td>6</td>
<td>Suzhou</td>
<td>45430</td>
<td>42800</td>
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<tr>
<td>7</td>
<td>Qingdao</td>
<td>45000</td>
<td>41465</td>
<td>8.53</td>
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<tr>
<td>8</td>
<td>Tangshan</td>
<td>44620</td>
<td>36500</td>
<td>22.25</td>
</tr>
<tr>
<td>9</td>
<td>Rotterdam port</td>
<td>44046</td>
<td>44153</td>
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<tr>
<td>10</td>
<td>Dalian</td>
<td>40840</td>
<td>37400</td>
<td>9.20</td>
</tr>
</tbody>
</table>

数据来源：上海国际航运中心发布的《全球港口发展报告（2013）》
1.2 Ship Emission and Regional Air Pollution

2013年12月5日11时PM$_{2.5}$浓度
PM$_{2.5}$ distribution on Dec. 5, 2013

中国及周边海域船舶分布图
Geographical Distribution of Ship in China
### 1.3 Ports Planning Priorities in YRD

<table>
<thead>
<tr>
<th>Port Groups</th>
<th>Ports</th>
<th>Transporting System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shanghai, Ningbo and Lianyungang port</td>
<td>Give priority to ports of Shanghai, Ningbo, Suzhou, including the ports along the middle and lower reaches of the Yangtze river such as Nanjing, Nantong, Zhenjiang port, and the other feeding ports of Lianyungang, Jiaxing, Wenzhou, Taizhou etc.</td>
<td>Composing the container transportation system of Shanghai International Shipping Center</td>
</tr>
<tr>
<td>Including Zhoushan, Wenzhou, Nanjing, Zhenjiang, Nantong, Suzhou and other ports</td>
<td>Give priority to ports of Shanghai, Ningbo, Suzhou, including the ports along the middle and lower reaches of the Yangtze river such as Nanjing, Nantong, Zhenjiang port, and the other feeding ports of Lianyungang, Jiaxing, Wenzhou, Taizhou etc.</td>
<td>Composing the container transportation system of Shanghai International Shipping Center</td>
</tr>
<tr>
<td></td>
<td>Give priority to with Shanghai, Nantong, Ningbo, Zhoushan port, and Nanjing port</td>
<td>Imported oil, natural gas discharged interim storage and transportation system</td>
</tr>
<tr>
<td></td>
<td>In Ningbo, Zhoushan, Lianyungang port is given priority to, as well as Shanghai, Suzhou, Nantong, Zhenjiang, Nanjing and other ports</td>
<td>System of imported iron ore transporting</td>
</tr>
<tr>
<td></td>
<td>Give priority to with Lianyungang port</td>
<td>Coal discharge and transportation system</td>
</tr>
<tr>
<td></td>
<td>Shanghai, Nantong, Lianyungang, Zhoushan and Jiaxing and other ports along the Yangtze river delta region</td>
<td>Grain transfer storage and transportation system</td>
</tr>
<tr>
<td></td>
<td>Shanghai, Nanjing and other ports</td>
<td>Commodity automobile transportation system</td>
</tr>
<tr>
<td></td>
<td>Ningbo, Zhoushan, Wenzhou port</td>
<td>Land islands ro-ro transportation systems</td>
</tr>
<tr>
<td></td>
<td>Shanghai port</td>
<td>Passenger transfer level cruise transport facilities in domestic and foreign</td>
</tr>
<tr>
<td></td>
<td>Lianyungang port</td>
<td>Imported crude oil, iron ore discharged interim storage and transportation system</td>
</tr>
</tbody>
</table>
1.4 Shipping status in YRD

- The rapid development of shipping industry
  - The cargo throughput of Shanghai Port and Ningbo-Zhoushan Port contributed 20.1% to the total sea harbor cargo throughput of China
  - Nanjing, Zhenjiang, Suzhou and other YRD ports contributed 54.4% to the total river harbor cargo throughput of China
  - In 2014, the container throughput of Shanghai Port was 35.2 million TEU, 4.7% more than that in 2013

注：数据来源交通部

http://www.moc.gov.cn/zfxxgk/bnssj/zhghs/201412/t20141215_1743806.html
Outline

1. Shipping Industry in Shanghai & YRD

2. Air Emission in Shanghai Port

3. Control strategies of Regional Cooperation in YRD
2.1 Shipping Emission and Air Pollution in Shanghai

- In 2010-2014, the Shanghai port container throughput increased year by year, ranks the world's first; Cargo throughput remains generally upward trend, second only to Ningbo-Zhoushan port, the world's largest

- Ship emission will be more important to the air quality improvement in the YRD
2.1 Shipping Emission and Air Pollution in Shanghai

Vessel Gross Tonnage Ratio

- Vessels in internal rivers: 6.9%
- River vessels in out-port: 22.9%
- Coastal vessels: 19.2%
- OGVs: 51.0%

Air Emission Share in Shanghai Port
2.2 Emission Inventory and Share in Shanghai, 2013

SO₂

PM₂.₅

NOₓ

VOCs
2.3 Contribution of PM$_{2.5}$ by Shipping in Shanghai

The chemical composition of PM$_{2.5}$ in Shanghai during 2012 to 2013:

- **Regional influence:** 16%~36%
- **Local sources:** 64%~84%
- **Mobile sources:** 29.2%
- **Industry:** 28.9%
- **Dust:** 13.4%
- **Coal burning:** 13.5%
- **Others:** 15.0%
- **Not detected**

其中船舶等非道贡献 Non-road: ~15%
2.4 Ship Emission Sampling
2.4 Ship Emission Sampling

- The NOx emission concentration of one river vessel was 6 times larger than a coal fired power plant without denitrification facilities, and 40 times larger than that with denitrification facilities.

- The PM emission concentration of one river vessel was 75 times larger than a coal fired power plant with dust removal facilities.
2.5 Shipping Emission Inventory in YRD based on AIS

- AIS (Automatic Identification System) is the collection of modern communication, network and information technology in the integration of new navigation equipment and security information system.

- Regional emission inventory
  - Base year: 2014
  - Domain: YRD (Shanghai, Jiangsu, Zhejiang, Anhui and Jiangxi)
### 2.6 Non-road Machinery Emission

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</tr>
</thead>
<tbody>
<tr>
<td>美国 U.S.</td>
<td>非道路柴油机 Non-road diesel engine</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Tier 3</td>
<td>Tier 3 interim</td>
<td>Tier 4</td>
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<tr>
<td>欧盟 EU</td>
<td>非道路柴油机 Non-road diesel engine</td>
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<td>Stage 3A</td>
<td>Stage 3B</td>
<td>Stage 4</td>
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<tr>
<td>中国 China</td>
<td>重型柴油机 Heavy-duty diesel engine</td>
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<tr>
<td></td>
<td>非道路柴油机 Non-road diesel engine</td>
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<td></td>
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<tr>
<td></td>
<td>船用柴油机 Marine diesel engine</td>
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</table>

- **港作机械**
  - 装载机
  - 堆料机
  - 起重机
  - 堆高机
  - 牵引车
Outline

1. Shipping Industry in Shanghai & YRD

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3.1 Experience in HK and PRD

- Fair Winds Charter: voluntary industry-led example
  - Started from 2011 – 2012; extended in 2013 and 2014
  - Industry-led action to switch fuel at berth, extra cost paid by the industry
  - Urge Hong Kong Government to regulate ship emission control to create a level playing field; and to collaborate with Guangdong Government to promote uniform regulation and policy in the region

- Government incentive scheme
  - Incentive scheme from September 2012 to encourage ocean-going vessels to switch fuel at berth
  - Ocean-going vessels using fuel with not more than 0.5% sulphur content will have their port facilities and light dues reduced by 50%
3.1 Experience in HK and PRD

- Government regulation
  - 2013 Policy Address included a number of policy recommendations to reduce ship emissions, such as to regulate at-berth fuel switching, encourage the use of on-shore power, improve the quality of local marine light diesel, and to strengthen regional collaboration.

- Clean Air Plan for Hong Kong (2013)
  - To set up an emission control area in the PRD.
3.2 Suggestion—— Legislations

The air pollution prevention law of the people's Republic of China has been amended by the sixteenth session of the Standing Committee of the Twelfth National People's Congress of the people's Republic of China on August 29, 2015, and shall be implemented on January 1, 2016.

National laws

Local laws

Standards
3.3 Bottleneck and Challenge of Shipping Emission

- OGVs using high sulfur content fuel
  - OGVs follow MARPOL convention
  - Low sulfur content fuel must be used in ECAs. ($S\% \leq 0.1\%$, since July, 2015)
  - In other district, the upper limit of the fuel’s sulfur content is 3.5%

- Domestic vessel
  - There is no emission regulation about the newly built marine engine which power is greater than 37 kW
  - the Compulsory retirement age of the transport ship is 25-41 years
  - Marine fuel inspection is necessary
3.4 Bottlenecks and problems-Non-road machinery

- The non-road machinery pollution prevention regulation at the national level legal basis has not set up
  - There is no clear requirements of non-road machinery pollution prevention
  - There is no management basis for new non-road machinery emission
  - There is no management basis for in-use non-road machinery

- The whole life cycle supervision responsibility main body of non-road machinery is not clear
3.5 Proposals for Ship Air Pollution Control

**National Level: Atmospheric Pollution Prevention Law**

- Article 13: To develop fuel oil quality standard, shall meet the national air pollution control requirements, and with the air pollutants emission standards of motor vehicles and vessels, non-road machinery, synchronous implementation. Clarify the state and local responsibility.

- Article 23: The competent department of environmental protection at or above the county level shall be responsible for the organization of construction and management of pollution sources network and ambient air quality monitoring network, taking the ambient air quality and emission monitoring, Uniformly release the atmospheric environment quality condition information.
3.5 Proposals for Ship Air Pollution Control

- **National Level**: Atmospheric Pollution Prevention Law
  - Article 38: City people's government can define and publish the forbidden zone of the seriously polluting fuels, in accordance with the requirements of atmospheric environmental quality improvement, and gradually expand the scope of forbidden zone.

- **Regional**: Study on the feasibility of sulfur oxides and nitrogen oxide emissions control area of the ship

- **Local level**:
  - Determine the ECA’s scope
  - Study the relevant laws, regulations and supporting measures
3.6 Proposals for Off-road Emission Control

- YRD Level
  - Establish the regional marine pollution prevention and control Cooperative area in Yangtze River Delta
  - Eliminate high emission vessels
  - Jointly implement the stricter emission standard of new vessels
  - Study the emission standards of in-use vessels
  - Pilot on large river vessels using shore power
  - Study the feasibility and subsidy policy of the new marine energy

- Non-road machinery
  - Establish the emission labeling system
  - Establish filing system
  - Establish a regular inspection system
  - Upgrade the engine with using new energy
  - Using DPF
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- 复旦大学 马蔚纯 张艳
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- 上海市港政中心 程健敏
- 上海市海事局 王星星 徐旻等
- 上海地方海事局 徐志勇等
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